UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

APR 6 1995

MEMORANDUM FOR: Distribution

FROM: George Darcy
Chief, Plans and Regulations Division

SUBJECT: Amendment 35 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area

Attached are the subject amendment and associated documents prepared by the North Pacific Fishery Management Council for formal review under the Magnuson Fishery Conservation and Management Act.

This action would establish an area closed to fishing with trawl gear from August 1, through August 31, and after August 31 upon attainment of a 42,000 nonchinook salmon incidental catch limit, through October 14. This area, the chum salmon saving area, is located in the Bristol Bay portion of the Bering Sea and is intended to reduce the incidental catch of chum salmon in the Bering Sea pollock fishery.

Please provide your comments (including "no comment") by May 22, 1995. If you have any questions, please call Don Leedy at (301) 713-2341.

Attachments

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AMENDMENT 35 - TEXT TO AMEND THE FMP FOR THE GROUNDFISH FISHERY OF THE BERING SEA AND ALEUTIAN ISLANDS AREA

1. In Chapter 2.0, section entitled "History and Summary of Amendments," add the following:

Amendment 35 implemented on , 1995

(1) Established a trawl closure area called the Chum Salmon Savings Area.

2. In chapter 14 entitled "Management Regime," the following sections are amended:

Under Section 14.4.3. entitled "Fishing Area Restrictions,"

In Section 14.4.3.2, entitled "Trawl Fishery," paragraph E is added to read as follows:

E. Chum Salmon Savings Area. (As described in Appendix III and Figure 27d)--Closed to trawling from August 1 through August 31. In addition, when the Regional Director determines that 42,000 non-chinook salmon have been caught by vessels using trawl gear during the time period of August 15 through October 14 in the catcher vessel operational area, NMFS will prohibit fishing with trawl gear for the remainder of the period September 1 through October 14 in the chum salmon savings area. Accounting for the 42,000 fish bycatch limit will begin on August 15.

3. In Appendix III, entitled "Description of Closed areas, add number 9 as follows:

9. Chum Salmon Savings Area Trawling is prohibited from August 1 through August 31 and after September 1, upon the attainment of a bycatch limit of 42,000 "other" salmon taken within the CVOA, through October 14, within the area bounded by a straight line connecting the following pairs of coordinates in the order listed:

56°00'N., 167°00'W.;
56°00'N., 165°00'W.;
55°30'N., 165°00'W.;
55°30'N., 164°00'W.;
55°00'N., 164°00'W.;
55°00'N., 167°00'W.;
56°00'N., 167°00'W.

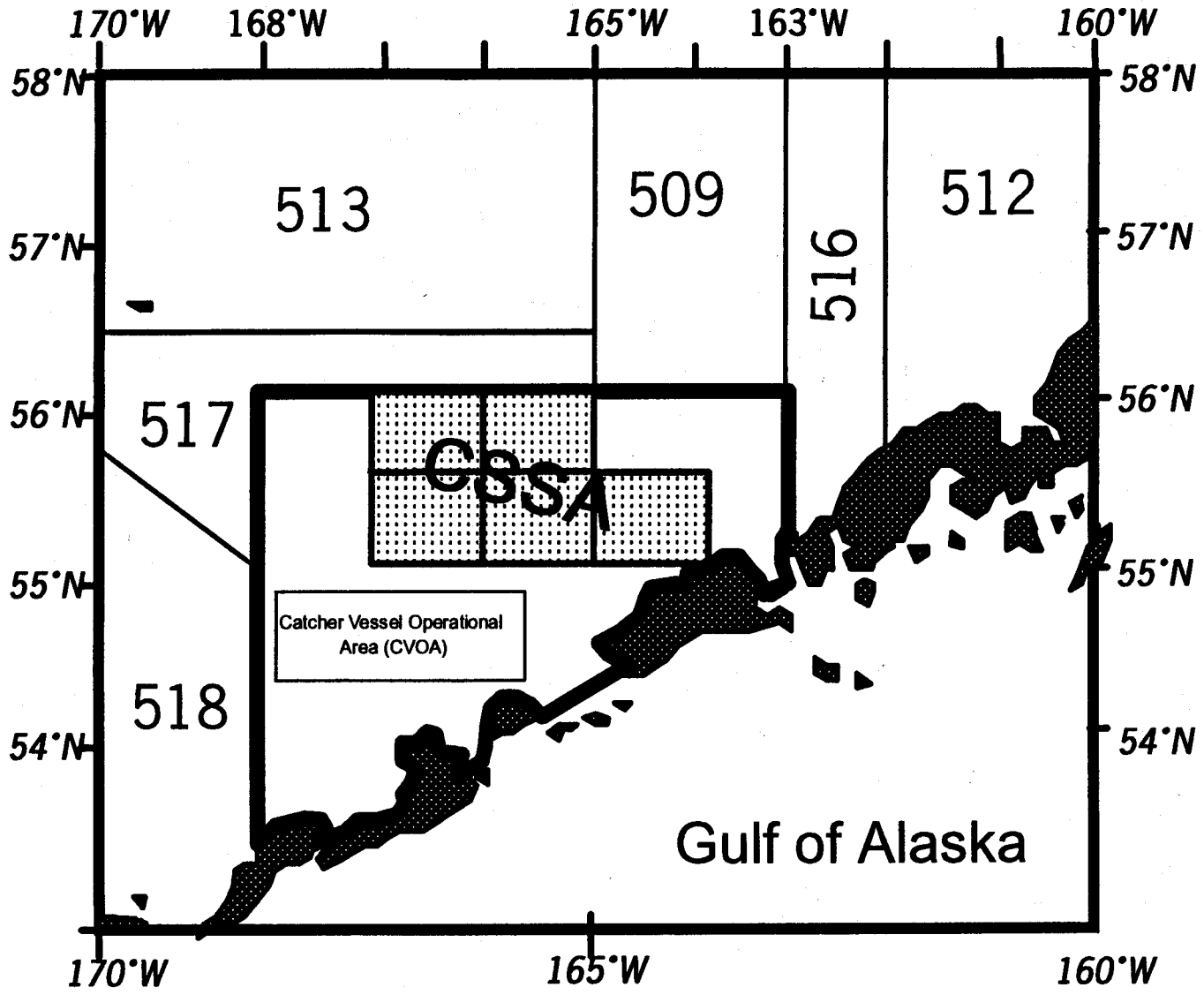

Figure 27d. Chum Salmon Savings Area (CSSA)

DRAFT FOR SECRETARIAL REVIEW

Environmental Assessment/Regulatory Impact Review/
Initial Regulatory Flexibility Analysis
of

Proposed Alternatives to Reduce Chum Salmon Bycatch in the Bering Sea Trawl Fisheries:

Amendment 35

to the Fishery Management Plan
for the Bering Sea/Aleutian Islands Groundfish

Prepared by

Alaska Department of Fish and Game
National Marine Fisheries Service
North Pacific Fishery Management Council

March 21, 1995

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EXECUTIVE SUMMARY

"Other" salmon bycatch in the 1993 BSAI mid-water trawl fisheries, comprised mostly of chum salmon, was significantly higher than in any prior year on record. Historically most of the chum salmon bycatch occurs in an area coincidental with the Catcher Vessel Operational Area (CVOA) during the period which coincides with the pollock 'B' season. The high bycatch caused concern from a management standpoint because there are currently no options available for controlling the bycatch of salmon which are a prohibited species. However, because of this high bycatch the Council took emergency action in April of 1994 to close an area identified as having historically high chum salmon bycatch after a pre-defined cap was attained. This EA/RIR/IRFA contains an analysis of the potential impacts of a range of time and area closure alternatives to control "other" salmon bycatch in BSAI groundfish trawl fisheries.

Specifically, this document examines three management alternatives (and presents one Alternative 4 that is not analyzed in this document, see below), and a total of nine closure options (seven options and two suboptions). These include the Status Quo as Alternative 1, and two additional alternatives requiring either year-round or partial-year area closures which could potentially reduce the "other" salmon bycatch especially in the CVOA. Options for "other" salmon bycatch management in this document define areas for closure based upon existing management areas coincidental with high "other" salmon bycatch, as well as discrete areas within larger management areas. This document also outlines two associated factors that, under Alternative 3, are necessary to monitor the "other" salmon bycatch. These include: 1) extra observer coverage on motherships that receive groundfish harvested in the CVOA during the pollock 'B' season and, 2) electronic communication capabilities on affected motherships and shoreside processors with 100 percent observer coverage that receive groundfish harvested in the CVOA during the pollock 'B' season.

In 1993, the "other" salmon bycatch in the Bering Sea and Aleutian Islands management area (BSAI) was approximately 245,000 salmon. This was more than triple the previous high bycatch level, and six times the bycatch level seen in the previous two years. The vast majority of these "other" salmon were assumed to be chums. Conservatively, the historical species composition of "other" salmon bycaught in the BSAI groundfish fisheries is approximately 95% chum salmon in any given year.

Concerns about chum salmon bycatch were exacerbated by the poor returns to Western Alaskan systems in the same year. Commercial, subsistence, and recreational fisheries were closed in several of the Western Alaskan districts in 1993 because of poor returns, and projections for 1994 were for "below average returns" in many of these districts, as well. However, Western Alaskan chum salmon runs were average or above average in number during 1994.

The chum salmon intercepted in the BSAI groundfish fisheries in 1993 were primarily in the size range of 3 year-old fish which would have been expected to mature in 1994 and 1995. The majority of the 1993 chum salmon bycatch occurred after most of the Western Alaskan chum salmon would have returned to their native systems. Little is known about the potential impacts bycatch may have had on returns in 1994 and subsequent years, especially since source of origin stock composition of the bycaught "other" salmon is unknown.

The purpose of this analysis is to provide information needed to take possible action to reduce "other" salmon bycatch. An Emergency Rule (ER), patterned on one of the alternatives and one of the closure options was in place for the 1994 pollock 'B' season. That ER will expire prior to the 1995 fishing season. If the Secretary is to have the management authority to address future "other" salmon bycatch problems in the BSAI trawl fisheries, it will be necessary for the Council to adopt an amendment to the BSAI Groundfish Management Plan, prior to the start of the 1995 pollock 'B' season on August 15.

This analysis examines the domestic groundfish trawl fisheries in 1990 through 1993 for patterns in "other" salmon bycatch. It is important to note, however, that only the fisheries conducted in 1993 were in spatial and temporal patterns similar to those anticipated in the future, given prevailing management regulations. This is so because of recent changes in regulations governing the timing of the pollock 'B' season (August 15 opening date, as of 1993), and the establishment of the CVOA (effective June 1, 1992). Additionally, some operations began harvesting pollock in the summer months under the Community Development Quota (CDQ) Program, beginning in 1993. The smallest unit examined for potential closure in this document was the 1/2° latitude by 1° longitude block.

Given the intra-annual and inter-annual variability in spatial distribution of observations of relatively high bycatch, as well as the substantial mobility of both pollock stocks and salmon in these areas of the BSAI, a trade-off between potential groundfish catch and potential salmon bycatch savings becomes apparent, though difficult to quantify. That is, either large areas may be selected for closure to ensure larger potential "other" salmon bycatch savings, or small areas may be chosen in order to reduce closure impacts on existing groundfish fisheries.

The specific objectives of this FMP amendment are to, 1) provide a mechanism by which to accurately assess and reduce excessive "other" (chum) salmon bycatch in the BSAI groundfish fisheries, 2) achieve a given bycatch reduction with the smallest possible adverse impact on the domestic groundfish harvesting and processing industry, and 3) assure that any action is balanced and equitable to all segments of the industry.
Four alternatives, seven options, and two sub-options for time/area closures were considered. They include:

Alternative 1: Status quo. Under the status quo, no regulatory authority would exist for NMFS (on behalf of the Secretary) to close areas of the BSAI to trawling to prevent large numbers of "other" salmon from being taken as bycatch in the groundfish fisheries.

Alternative 2: A specific area (depending upon the closure option selected) of the BSAI would be closed to all trawling from January 1 through December 31. This alternative would potentially reduce "other" salmon bycatch, but might be considered to be too restrictive to the affected trawl industry, because it would eliminate all trawling within a specified area for the entire calendar year, whereas "other" salmon bycatch could be a problem only during a portion of the year.

Alternative 3 (preferred): A specified area of the BSAI (depending upon the closure option selected) will be closed to all trawling for that portion of the year generally shown to have high other salmon bycatch (the month of August), with the closure continuing or being reinstated once a bycatch limit of 'other' salmon has been reached in the CVOA. The specified area would reopen to trawling on October 15, when chum salmon bycatch has historically been low. This alternative is less restrictive than Alternative 2 because it would only close a specified area during the period of highest bycatch impact on other salmon. In a recent ER, the Council established the bycatch limit at 42,000 salmon, which represents 50 percent of the 1991, 1992, and 1993 average of "other" salmon caught in the CVOA. In recent years the CVOA has represented approximately 80% of the total other salmon bycatch in the Bering Sea. Under Alternative 3 the Council has the option of choosing another number for the cap.

The adoption of Alternative 3 in concert with a cap requires additional observer coverage on motherships and some shoreside processors that receive groundfish caught in the CVOA during the pollock 'B' season so that the bycatch numbers can be accurately determined and transmitted daily. It would also require the affected motherships and shoreside processors subject to 100 percent observer coverage and receiving groundfish harvested in the CVOA during the pollock 'B' season,

to have the necessary hardware and software available for the observers to transmit salmon bycatch data electronically on a daily basis. Both of these requirements were implemented for the 1994 pollock "B" season under emergency rulemaking.

Alternative 4: Change the 'B' season starting date. An alternative to avoid other salmon bycatch would be to move the start of the 'B' season back to June 1. The EA/RIR/FRFA that was originally prepared for the change in the 'B' season start date analyzes the impact and no further discussion is presented in this document (EA/RIR/FRFA for the Delay of the Pollock 'B' season in the Bering Sea and Aleutian Islands, April 27, 1993).

The seven options, and two sub-options, for area closures identified under both Alternative 2 and Alternative 3 are identified below:

Option 1: "The Contour". A 15 mile buffer extending to either side of the 200 meter (m) depth contour which extends to the north and west from the "horseshoe" and Unimak Island (Figure 1). This contour buffer was found to correspond to high chinook salmon bycatch, as presented in Amendment 21b to the BSAI Groundfish FMP.

Sub-option 1b: "The Contour within the CVOA". That portion of the contour, identified in Option 1, which lies within the CVOA, as described in Option 3.

Option 2: "The Contour plus Unimak". The area defined under Option 1 above, plus two 1/2 degree by 1 degree blocks to the north of Unimak Island and the "horseshoe" (Figure 1). The combination of these blocks with the contour buffer accounted for a high percentage of chinook bycatch in Amendment 21b.

Sub-option 2b: "The Contour within CVOA plus Unimak". The portion of Option 2 lying within the CVOA as described in Option 3.

Option 3: "The CVOA". The Catcher Vessel Operational Area (CVOA), as currently described for management of inshore and offshore fisheries during the pollock 'B' season (Figure 2).

Option 4: "Area 517". NMFS management area 517 (Figure 3).

Option 5: "9 blocks". The nine blocks which form the top portion of the CVOA extending to the west from Unimak Island, and including a block above the northwest corner of the CVOA (Figure 4).

Option 6: "7 blocks". The seven blocks identical to those described in Option 5 with the two above Unimak Island deleted (Figure 5).

Option 7 (preferred): "5 blocks". The five blocks approximating the north-central portion of the CVOA (Figure 6). This area closure was implemented under the 1994 emergency rule.

The management "alternative/option" combination that is least exclusive (i.e., impacts the smallest possible area), while assuring equitable and balanced treatment for all segments of the groundfish trawl fishery, and yet offers some protection to "other" salmon is Alternative 3, Option 7.

The Preferred Alternative

In January 1995, the Council adopted as it's preferred alternative, the Alternative 3, option 7 as detailed in this document, with several modifications. The preferred alternative will close the 5-block area in the CVOA to all trawling from August 1 through September 1, a period when other salmon bycatch has been historically high. When the bycatch within the CVOA reaches 42,000 other salmon (accounting to begin August 15, the start of the pollock 'B' season), then the 5-block area will either remain closed (if cap reached by September 1) or will close to trawling when the cap is reached. The 5-block area will reopen to trawling on October 15, when chum salmon have historically been gone from this area.

1.0 Introduction

The groundfish fisheries in the Exclusive Economic Zone (EEZ) [between 3 and 200 miles offshore] off Alaska are managed under the Fishery Management Plan (FMP) for the Groundfish Fisheries of the Gulf of Alaska (GOA) and the FMP for the Groundfish Fisheries of the Bering Sea/Aleutian Islands Area (BSAI). Both FMPs were developed by the North Pacific Fishery Management Council (Council) under the Magnuson Fishery Conservation and Management Act (Magnuson Act). The GOA FMP was approved by the Secretary of Commerce and became effective in 1978, and the BSAI FMP became effective in 1982.

Actions taken to amend FMPs or implement other regulations governing the groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA).

NEPA, E.O. 12866 and the RFA require a description of the purpose and need for the proposed action as well as a description of alternative actions which may address the problem. This information is included in Section 1 of this document. Section 2 contains information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are also addressed in this section. Section 3 contains a Regulatory Impact Review (RIR) which addresses the requirements of both E.O. 12866 and the RFA that economic impacts of the alternatives be considered. Section 4 contains the Initial Regulatory Flexibility Analysis (IRFA) required by the RFA which specifically addresses the impacts of the proposed action on small businesses.

This Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA) addresses a proposed amendment to the FMP for Bering Sea groundfish fisheries that would establish the authority for NMFS (on behalf of the Secretary) to close a specified area of the Bering Sea to all trawling in order to reduce "other" salmon bycatch mortality. The first of two alternatives to the status quo under consideration would close a specified area of the Bering Sea (depending upon the closure option selected) to all trawling from January 1 through December 31 each year. Under the second of the two alternatives to the Status Quo, the specified area closure to all trawling (depending upon the option selected), would occur either after the period when chum salmon bycatch could be expected to increase (e.g. July 1), or after an "other" salmon bycatch cap was exceeded, and would extend until October 15.

In April 1994, the NPFMC requested an Emergency Rule (ER) be established during the 1994 pollock "B" season to help reduce potential bycatch prior to consideration of this amendment. In order to implement the ER which stipulated closure of a 5 block area following a bycatch of 42,000 "other" salmon, NMFS determined that the following would be necessary: 1) that two observers would be required on each mothership receiving groundfish harvested in the CVOA during the pollock 'B' season, and 2) that the above-mentioned motherships, as well as shoreside processors receiving pollock harvested in the CVOA during the pollock 'B' season and carrying 100 percent observer coverage, would be required to have the necessary hardware and software to transmit observer data electronically.

Salmon bycatch controls for the domestic fishery were first analyzed as part of Amendment 21 to the BSAI groundfish FMP. The final version of Amendment 21 contained only bycatch measures for halibut, however, and analysis to address salmon bycatch was separated from the original analysis. Proposed salmon bycatch measures were analyzed and a discussion paper on chum salmon bycatch

was reviewed by the Council in April, 1994. The analysis was further revised into an EA/RIR for plan amendment, and reviewed by the Council at it's September 1994 meeting, and minor revision were recommended. The revised document was completed on December 1, and released for public review on December 14, 1994. At its January 1995 meeting, the Council considered the testimony and recommendations of its Advisory Panel, Scientific and Statistical Committee, fishing industry representatives, and the general public on alternatives to reduce the bycatch of chum salmon in the groundfish fisheries. The Council reviewed the information on potential impacts of the alternatives contained in the December 1 analysis, and recommended that the Secretary adopt Alternative 3, option 7, with several modifications as described elsewhere in this document.

1.1 Purpose of and Need for Proposed Action

In 1993, the "other" salmon bycatch in the BSAI of approximately 245,000 salmon more than tripled the previous high bycatch level of approximately 72,000 "other" salmon in 1984, and was six times the bycatch level seen in either 1991 or 1992. Historical data indicate that, conservatively, 95% of this "other" salmon bycatch is comprised of chum salmon. Therefore, the terms "other" salmon and chum salmon will be used interchangeably in discussing this Bering Sea trawl salmon bycatch reduction proposal.

Concerns about chum salmon bycatch were exacerbated by the extremely poor returns to Western Alaskan systems experienced in 1993. As a result, commercial, sport, and subsistence fisheries were closed in several of the Western Alaskan districts in 1993, and initial projections for 1994 were for below average returns in many of these districts, as well.

According to the NMFS observer program, the intercepted chum salmon in the BSAI groundfish trawl fisheries were primarily in the size range of 3 year-old fish which would be expected to mature in 1994 and 1995. The chum salmon were also captured after most of the Western Alaskan chum salmon which were spawning during 1993 would have returned to their natal systems. Little is known about the potential impacts bycatch will have on 1994 and subsequent years' returns, especially since source of origin stock composition of the bycaught salmon is uncertain.

The purpose of this analysis is to provide information needed to take possible action to reduce "other" salmon bycatch in BSAI trawl fisheries. This analysis examines 1990 through 1993 domestic fisheries for patterns in "other" salmon bycatch. It also employs NMFS annual and triennial groundfish survey data over the period 1988 through 1993. It should be noted that only the fisheries conducted in 1993 reflect spatial and temporal patterns in "other" salmon bycatch similar to those anticipated in the immediate future. This is so because of recent changes in regulations governing the timing of the pollock 'B' season (fishery opening August 15 as of 1993), and the establishment of the CVOA (effective June 1, 1992 through 1995).

In this EA/RIR/IRFA, areas for potential closure were defined based on an analysis of the patterns in "other" salmon bycatch, especially in 1993. It is possible that more refined, or alternative areas, may become apparent as additional information is obtained over successive fishing seasons. The smallest unit examined for potential closure in this document was the 1/2° latitude by 1° longitude block.

The distribution of chum salmon, noted in historical fisheries, covers a fairly large area, and is not necessarily confined to discrete areas smaller than blocks or even to small aggregations of blocks. Given the intra-annual and inter-annual variability in spatial distribution of observations of relatively high bycatch, as well as the substantial mobility of both pollock stocks and "other" salmon in these areas of the BSAI, a trade-off between potential groundfish catch and potential salmon bycatch

savings becomes apparent, though not quantified. That is, the size of the area of closure may have differential impacts on either chum salmon bycatch savings or on domestic groundfish harvest. It must also be acknowledged that, while the best historical bycatch data have been employed in identifying trawl interception patterns, changes in oceanographic or other environmental factors, shifts in the timing and/or location of groundfish fishing effort, as well as variation in the relative abundance and distribution of both pollock and "other" salmon year classes, may result in continued bycatch outside of the proposed closure areas.

1.2 Alternatives Considered

Four alternatives are presented in this document. The Status Quo (or "No Action") alternative, two alternatives utilizing time/area closures and a fourth alternative moving the 'B' season start date back to June 1. The last alternative is not analyzed in this document; refer to the analysis specified under Alternative 4 below. Under Alternatives 2 and 3, seven options, and two sub-options, for closure areas have been examined. The closure areas, described below, were based largely on existing management areas or on 30 mile by 30 mile (1/2° latitude by 1° longitude) blocks corresponding to observed high "other" salmon bycatch.

With the exception of a 15 mile buffer extending to either side of the 200 meter (m) depth contour, square blocks, or areas previously defined in regulation (such as NMFS management area 517), were chosen on the basis of enforceability considerations. In several alternative areas, blocks were selected which would maintain access by trawlers to the "horseshoe" area in the CVOA which, although containing "other" salmon bycatch, did not account for inordinately high bycatch totals. The horseshoe represents an especially important and productive pollock fishing area.

The four management alternatives are as follows:

Alternative 1: Status quo. Under the status quo, no authority would exist for NMFS (on behalf of the Secretary) to close areas of the BSAI to trawling to prevent large numbers of "other" salmon from being taken as bycatch in the groundfish fisheries.

Alternative 2: A specific area (depending upon the closure option selected) of the BSAI would be closed to all trawling from January 1 through December 31, each year. This alternative would potentially reduce "other" salmon bycatch, however, since "other" salmon bycatch appears to occur only during a portion of the year, the alternative could be considered to be too restrictive to the trawl industry, because it would eliminate trawling within a specified area for the entire calendar year.

Alternative 3 (preferred): A specified area of the BSAI (depending upon the closure option selected) will be closed to all trawling for that portion of the year generally shown to have high other salmon bycatch (the month of August), with the closure continuing or being reinstated once a bycatch limit of 'other' salmon has been reached in the CVOA. The specified area would reopen to trawling on October 15, when chum salmon bycatch has historically been low. This alternative is less restrictive than Alternative 2 because it would only close a specified area during the period of highest bycatch impact on other salmon. In a recent ER, the Council established the bycatch limit at 42,000 salmon, which represents 50 percent of the 1991, 1992, and 1993 average of "other" salmon caught in the CVOA. In recent years the CVOA has represented approximately 80% of the total other salmon bycatch in the Bering Sea. Under Alternative 3 the Council has the option of choosing another number for
the cap.

During the 1994 season, the components of the "other" salmon ER closure which represent an option under this alternative included additional observer requirements for motherships receiving groundfish caught in the CVOA during the pollock 'B' season. The extra observer is necessary to ensure accurate and timely counts of salmon bycatch, without compromising the other groundfish sampling duties of the observer. Because a large number of hauls are delivered to mothership processor vessels compared to some other processors a greater burden would be placed on a single observer. Because of the large number of deliveries that are also made to some shoreside processing plants an extra observer would be required on those shoreside processing plants that offload fish at more than one location on the same dock and have distinct and separate equipment at each location to process those fish. The ER also included requirements for the affected motherships, and for shoreside processors that are subject to 100 percent observer coverage and that received groundfish harvested in the CVOA during the pollock 'B' season, to have the necessary hardware and software available for the observers to transmit salmon bycatch data electronically. These requirements are necessary to enable the observers to report haul-by-haul statistics and salmon bycatch numbers on a daily basis, which would allow NMFS to monitor the other salmon cap more effectively.

Under the ER, hardware and software acquisition has previously been incurred by most vessels and plants processing in 1994; although some minor changes to the requirements have been made for this amendment. Processors that do not have all of the necessary equipment would be required to acquire the specified hardware and software. Under the ER a PC with a 386 or better processing chip and 5 megabytes of free hard disk storage was required; however, under this amendment a 486 processing chip with 10 megabytes free hard disk storage and 8 megabytes RAM would be required for both motherships and shoreside processing plants. For observers to provide daily reports, NMFS would require that all motherships that receive fish caught in the CVOA during the pollock 'B' season provide INMARSAT Standard A satellite communication capabilities and associated software (cc mail remote and a data entry program provided by the Regional Director) for observers' use. Each mothership must also have available for observers' use a personal computer (PC) with a 486 or better processing chip, a DOS version 3.0 operating system or better and 10 megabytes free hard disk storage with 8 megabytes RAM.

Under this alternative, each shoreside facility that receives pollock harvested in the CVOA during the pollock 'B' season, and that is required to have 100 percent observer coverage, would be required to have the capability to transmit data over telephone lines using a computer modem. These processors would be required to make available to observers a PC with a 486 or better processing chip, with at least a 9600 Baud modem and a phone line. The PC needs to be equipped with Windows 3.1 and have at least 10 megabytes of free hard disk storage and 8 megabytes RAM. The affected processors will also be required to obtain for observers' use the data entry software program provided by the Regional Director. The NMFS Observer Program Office may provide installation of the software programs to both motherships and shoreside processors.

Alternative 4: Change the 'B' season starting date. An alternative to avoid other salmon bycatch would be to move the start of the 'B' season back to June 1. The EA/RIR/FRFA that was originally prepared for the change in the 'B' season start date analyzes the impact and no further discussion is presented in this document (EA/RIR/FRFA for the Delay of the Pollock 'B' season in the Bering Sea and Aleutian Islands, April 27, 1993).

1.2.1 Area Closure Options

Seven options, and two sub-options, for area closures identified under both Alternative 2 and Alternative 3 are described below:

Option 1: "The Contour". A 15 mile buffer extending to either side of the 200 m depth contour which extends to the north and west from the "horseshoe" and Unimak Island (Figure 1). This contour buffer was found to correspond to high chinook salmon bycatch as presented in Amendment 21b to the BSAI Groundfish FMP.

Sub-option 1b: "The Contour within the CVOA". That portion of the contour, identified in Option 1, which lies within the CVOA, as described in Option 3.

Option 2: "The Contour plus Unimak". The area defined under Option 1 above, in addition to two 1/2 degree by 1 degree blocks to the north of Unimak Island and the "horseshoe" (Figure 1). The combination of these blocks with the contour buffer accounted for a high percentage of chinook bycatch in Amendment 21b.

Sub-option 2b: "The Contour within CVOA plus Unimak". The portion of Option 2 lying within the CVOA as described in Option 3.

Option 3: "The CVOA". The Catcher-Vessel Operational Area (CVOA), as currently described for management of inshore and offshore fisheries during the pollock 'B' season (Figure 2).

Option 4: "Area 517". NMFS management area 517 (Figure 3).

Option 5: "9 blocks". The nine blocks which form the top portion of the CVOA extending to the west from Unimak Island, and including a block above the northwest corner of the CVOA (Figure 4).

Option 6: "7 blocks". The seven blocks identical to those described in Option 5 with the two above Unimak Island deleted (Figure 5).

Option 7 (preferred): "5 blocks". The five blocks approximating the north-central portion of the CVOA (Figure 6).

1.3 Context for the Proposed Action

1.3.1 Observer Data

The catch and bycatch data used in this document are, primarily, observer data collected, compiled, and provided by the NMFS observer program. The observer data are for individual observed hauls and have not been extrapolated to represent hauls which were not observed. The number of salmon were determined either by an accurate count when the whole haul had been observed, or were estimated by the extraction of basket samples if it was not possible to sample the entire haul. When basket samples have been made, the bycatch numbers have been expanded from the sample to the whole haul. Data collected after 1994 will contain actual counts of salmon due to regulations which require that all salmon be retained onboard a vessel until they are counted and sampled by an observer.

Bycatch species composition is determined for sampled hauls during the year. In order to estimate the number of chinook and "other" salmon in hauls for which species composition was not recorded, the following stepwise algorithm was followed using hauls with available species composition: if at least five observations with species composition within a specific block (1/2° latitude by 1° longitude) and month were available, the percentage of chinook and "other" salmon for that month and block were multiplied by the total number of salmon in a haul in that month and block to arrive at the

number of each species; otherwise, if at least five observations for a month and defined area (Figure 7) were available, the percentage of chinook and "other" salmon for that month and area were multiplied by the total number of salmon from a haul; otherwise, if at least five observations from that month were available, the total number of salmon in a haul was multiplied by the percentage of salmon by species group in that month; otherwise if at least five observations from either the period of January - April, or May - December were available, the number of salmon was multiplied by the percentage of chinook salmon in that season ("other" salmon being the remainder); otherwise if at least five observations from a fishery for the year were available, the percentage of chinook salmon and "other" salmon for the entire fishery were used to calculate the number of chinook salmon and "other" salmon in a haul; otherwise the percentage of chinook and non-chinook salmon for the entire year was used to calculate the number of salmon in a haul.

The rationale for this approach was that the percentage of chinook salmon encountered in hauls was both time and area related. The percentage of chinook salmon in a haul was likely to be most similar to hauls from the same block and month, or from a similar larger area and month, or from a similar month, or from a similar season. The same was true for "other" salmon. The use of the season and larger area variables to define similar chinook salmon percentages was confirmed by a general linear model in which area and season were explanatory variables for chinook salmon percentages.

The current analysis includes only those vessels whose catch composition was defined as midwater pollock, bottom trawl for pollock, or bottom trawl for Pacific cod, since these fisheries have been previously identified as having relatively high salmon bycatch. Data from 1993 are estimated to contain 90% of observer data, as available at the time. NMFS annual and triennial groundfish survey data over the period 1988 through 1993 are also used in this document to indicate the distribution of pollock at the time of the survey in each year.

The primary data used in determining areas of high chum bycatch are from the 1990 through 1993 domestic fisheries. Since 1993 is the only year representing the current management regime, bycatch from 1993 was the primary source for spatial and temporal analysis.

1.3.2 Trawl Fisheries Background

Pollock harvests during the 'B' season (begins August 15) are apportioned between the "inshore" and "offshore" components of the industry. During the 1993 'B' season, the inshore component which was comprised of shoreside processing plants, mothership vessels, and trawl catcher/processors, processed approximately 235,000 mt of pollock (Source: NMFS "blend" data). The offshore component was comprised of mothership processors and trawl catcher/processors some of which also acted as motherships for some portion of the season by taking pollock deliveries from catcher vessels. The offshore component harvested about 414,000 mt of pollock during the 1993 directed 'B' season fishery.

Amendment 18 to the FMP for the Groundfish Fishery of the Bering Sea established a Catcher Vessel Operational Area (CVOA), as one component of the Inshore/Offshore apportionment of the pollock 'B' season quota. Access to the CVOA during the 'B' season is limited to catcher vessels delivering either to inshore processors or motherships, i.e., vessels are prohibited from operating in this area as catcher/processors during the 'B' season.

In 1993 (as in previous years), most of the "other" salmon trawl bycatch occurred within an area corresponding to the CVOA. Because areas of high "other" salmon bycatch and the area defined as the CVOA highly overlap, the alternatives proposed to ameliorate these "other" salmon bycatch losses focus primarily on portions of the BSAI which include some or all of the CVOA regulatory area.

Specifically, the two alternatives to the status quo, along with the seven options and two sub-options associated with each, involve potential closure of areas to groundfish fishing which would have a potentially disproportionate impact on the inshore component of the domestic pollock trawl industry. Except for Options 1, 4, 5, and 6, closure of the areas described would only affect the pollock harvest areas available to trawl catcher vessels delivering to shoreside processing plants and/or motherships. That is, because catcher/processors are excluded from operation in the CVOA during the 'B' season, any impacts attributable to the proposed closures accruing to this sector of the domestic industry would only be indirect, e.g., crowding externalities, etc.

Preliminary examination of 1993 fish tickets indicates that most of the pollock harvest by catcher vessels, during the 1993 'B' season, occurred within the CVOA. Most of the inshore processors received some pollock harvested within this area.

1.3.3 Species Composition of Bycaught Salmon

Although the term "other" salmon is used consistently throughout this report for non-chinook bycaught salmon, the majority of the other salmon are likely to be chum salmon. Annual NMFS observer reports of the foreign and Joint Venture (JV) fisheries estimated the percentage of each species of salmon bycaught in the historic trawl fisheries (1980-1989, as in Berger et al. 1984 and Guttormsen et al. 1990). Domestic reporting (since roughly 1989) available on the NMFS Bulletin Board has been generally divided into two categories: chinook salmon and "other" salmon. Examining the foreign and JV trawl fisheries for which species composition had been reported, an annual average of approximately 95% of the "other" (non-chinook) species bycaught in the BSAI were chum salmon. This average is actually assumed to be conservatively low because the two lowest values in computing the average (71% and 84%) were taken from early JV fisheries which captured less than 2,500 salmon in total. A percentage based on the total number of chum salmon to the total number all non-chinook salmon during the time period was 98%.

Figure 8 shows the historic percentages of "other" salmon which were chum salmon in the BSAI foreign and JV fisheries as reported by the NMFS observer program (as in Berger et al. 1984 and Guttormsen et al. 1990). These percentages are also plotted against the percentage of all salmon which were chinook in any given year. The plots indicate that in the BSAI, the percentage of "other" salmon which were chum salmon was fairly consistent, regardless of the ratio of chinook salmon to all other species. In this report, "other" salmon refers to all non-chinook salmon, and consists almost entirely of chum salmon.

1.3.4 "Other" Salmon Stock Composition in Trawl Fisheries

Little is known about the origins of chum salmon bycaught in the Bering Sea trawl fisheries. In their *17-18 November 1993, Technical Report*, the U.S./Canada Yukon River Salmon Technical Committee notes, "Yukon River salmon migrate out of the river and into the Bering Sea. Where they go once they enter the ocean is only partly understood, but evidence from tagging studies and the analysis of scale patterns indicate that these salmon spread throughout the Bering Sea, some move considerably south of the Aleutian Islands chain into the Gulf of Alaska and North Pacific Ocean, and some move north into the Chukchi Sea. While in the ocean, they mix with salmon stocks from Asia and elsewhere in North America." Scale pattern analysis has been mainly conducted on chinook salmon, so the primary information on Pacific Ocean ranges of chum salmon is from tagging studies.

Meyers, et al. (1990), report that in the Bering Sea and North Pacific, "... the abundance of Asian stocks has always been greater than that of North American stocks.", and that "The known ocean range of Asian chum salmon is remarkable." (See Figure 9 from Meyers, et al. 1990 for an example

of the general distribution.) Regarding North American chum salmon, Meyers states "The known ocean range of North American chum salmon is more restricted than that of Asian chum salmon..." and that "The known ranges of maturing chum salmon of both Asian and North American origin appear to be wider than those of immature fish, but there are many fewer recoveries of chum salmon tagged as immature fish than for those tagged as maturing fish." An area Meyers, et al. identify as being broadly overlapping in the Bering Sea for Asian and North American origin chum salmon is somewhat to the west of the CVOA, and in a personal communication, Meyers indicated that the closer one is to North America, the higher the probability that the fish would be of North American origin.

However, the tagging studies cited in Meyers et al. (1990) were not conducted in the same location nor at the same time of year as the pollock "B" season, and given the highly migratory nature of chum salmon, it would be difficult to estimate the percentage of chum salmon from any source. Illustrating a model of the migration patterns of chum salmon in the North Pacific Ocean, Fredin et al. (1977) indicate that immature salmon begin to migrate south, out of the Bering Sea in late summer and fall, and that immature and mature chum salmon are moving north into the Bering Sea in the spring and summer. Ogura and Ito (1994) analyzed data from chum salmon which were tagged in the high-seas from 1956 to 1991 and returned to Japan. These fish were generally tagged during the months of April - June in the North Pacific, and in June to August in the western Bering Sea. The tagging effort therefore followed the general migration of chum salmon which is to the north in the summer months. Estimates of the stock composition and distribution of chum salmon based on tagging data are highly dependant on the timing and location of the tagging effort, and data from fish tagged, for instance, in early summer in the Gulf of Alaska, would indicate little about the composition of fish in the Bering Sea in mid-August when and where little tagging effort has been conducted.

The mixing of stocks from the entire Pacific rim is especially pronounced in the North Pacific (e.g. south of the Aleutian Islands). To the south of the Bering Sea, Eggers, et al. (1989) indicated intermingling of Asian stocks, from Russia and Japan, with stocks from North America, including both U.S. and Canada, in the South Unimak and Shumagin Islands area. Rogers (1994), analyzed False Pass salmon fishery data and suggested that Japanese origin chum salmon could be an increasing component of fish mixing in the False Pass area. There is also some evidence that chum salmon stocks originating south of the Alaska Peninsula, e.g., from Southeast Alaska, British Columbia, and Washington, range into the Bering Sea, and chums from both eastern and western Bering Sea sources range southward into the Gulf of Alaska and North Pacific.

While the results of many of the studies cannot appropriately be extrapolated directly to the CVOA area of the Bering Sea, they do suggest the following: 1) substantial stock mixing is present throughout the Bering Sea, Aleutian Islands, and North Pacific, including the CVOA, 2) Asian stocks are more abundant than North American stocks (and Western Alaska stocks are only one component of the North American-source chums in the area (Figure 10)), 3) Japanese hatchery chums have increased significantly in abundance relative to North American stocks (Figure 10), and 4) at present, there are no definitive scientific data with which to determine the origin composition of CVOA trawl bycatches of "other" salmon. These conclusions are reinforced by the November 1993 findings of the Yukon River Salmon Technical Committee, which stated, "No information is available on which stocks of chum salmon were included in (bycatches in reporting areas 517 and 519, and the lower part of reporting area 509)", reporting areas which, in sum, approximate the CVOA.

It is likely that much of the "other" salmon bycaught during the 1993 season were not returning to Western Alaskan systems in 1993. The average weights of the fish sampled from the 1993 bycatch were 2.18 kg (4.8 lbs) and 2.01 kg (4.4 lbs) for males and females, respectively, and the average length of the fish was 56.7 cm and 55.3 cm for males and females, respectively (Source: NMFS Observer

Program, Seattle). The lengths recorded from the trawl vessels were from the tip of the snout to the fork in the tail. In order to compare these lengths with those recorded by ADF&G from returning fish which are measured from mid-eye to fork of tail, the lengths from trawl samples were multiplied by .9 to approximate mid-eye to fork measurements. Average length and weight by age for chum salmon returning to the Nushagak River are graphed in Figures 11 and 12 (Source: Rogers, 1994). The average weight and length (converted to mid-eye to fork approximations) from historical trawl data for "other" salmon are provided in Figures 11 and 12 as well (Source: NMFS Observer Program, Seattle). As the figures indicate, the "other" salmon bycaught in domestic trawls since 1989 have been much smaller on average than the fish returning to the Nushagak River. Such fish would be classified as "immatures" and expected to be one to two years from returning to Western Alaskan systems to spawn, if of Western Alaskan origin and assuming that the size at age data for the Nushagak River is similar to other Western Alaskan systems.

1.3.5 "Other" Salmon Directed Catch and Bycatch History

DIRECTED CATCH:

The directed catch of chum salmon in the Pacific Ocean has increased overall since 1970 (Figure 10). Japanese high seas catch dominated into the late 1970's when the coastal catch of chum salmon in Japan became the major commercial catch of chum salmon in the Pacific. The rise in the Japanese coastal catch coincided with increased Japanese hatchery production which has remained at approximately 2 billion fry per year since 1980. It should be noted that Figure 10 (based on data from Rogers 1994) does not include returns to the Hokkaido and Honshu Island hatcheries.

The directed commercial catch of chum salmon for the entire state of Alaska has varied between 8 million and 15 million fish, since 1980 (Figure 13). The commercial catch of chum salmon in the entire A-Y-K Region (Norton Sound, Kotzebue, Yukon and Kuskokwim fisheries) has varied between 1.2 million and 2.8 million fish, between 1980 and 1992. However, as reported to the NPFMC in January 1994 (Agenda D-2(a)(3)), only approximately 360,000 chum salmon were taken in the 1993 A-Y-K commercial fisheries (RAVEN Commission Report, ADF&G, 1994).

The commercial catch of summer run chum salmon on the Yukon River and of chum salmon on the Kuskokwim river have declined annually since the high catches reported in 1988 (Figure 14). The commercial catch of fall run chum salmon on the Yukon River has been in general decline since a high catch in 1981. Subsistence catches have been fairly constant since the mid-1970's. In spite of various commercial, recreational, and subsistence fishery closures on the Yukon and Kuskokwim Rivers, many systems did not meet minimum escapement goals in 1993 (discussed below). As indicated in the RAVEN report, chum salmon catches in the Westward (Chignik, Kodiak, and Aleutian Island/Alaska Peninsula fisheries) and Central Prince William Sound, Cook Inlet, and Bristol Bay fisheries) districts were below average in 1993, as well.

As of 9/12/94 there had not been a commercial opening for chum salmon on the Yukon River in 1994. Based on preliminary figures from the Alaska Department of Fish and Game (through 8/30/94), 40,320 chum salmon had been taken from the Yukon River in other directed fisheries in 1994, and 362,000 chum salmon have been taken on the Kuskokwim which has had commercial openings during 1994.

BYCATCH:

The "other" salmon bycatch in the BSAI was approximately 245,000 fish in 1993. This level of bycatch exceeded the previous year's bycatch of approximately 39,000 "other" salmon by six times, and

was triple the previous highest bycatch amount of approximately 72,000 "other" salmon estimated in the 1984 foreign trawl fishery (Figure 15). "Other" salmon bycatch was below 10,000 fish both prior to 1983, and between 1987 and 1989.

"Other" salmon bycatch is generally reduced during the winter months when, conversely, chinook salmon bycatch is highest. Although few "other" salmon are normally encountered during the winter months, there are years when fairly significant numbers can be taken. For instance, roughly 8% (based on estimated composition of observed hauls) of the "other" salmon bycatch was taken during the first two months of 1992 (Figure 16, top), when approximately 39,000 "other" salmon were bycaught in total. Approximately 4,500 "other" salmon were taken during the pollock "A" season of 1994.

The bycatch of "other" salmon in 1993 was very small in all months prior to July and August. Historically, "other" salmon bycatch has been elevated during the months of July through October (Figure 16, top). Approximately 67% of all "other" salmon in observed hauls were bycaught during August of 1991, and approximately 62% of all "other" salmon were taken during the month of September in 1993. In spite of the June opening of the pollock 'B' season in 1991 and 1992 (evident in Figure 17), few chum salmon were bycaught until July, August, and September, during those years. The delay of the 'B' season opening until August 15 in 1993 corresponded to high chum salmon bycatch in August and September of that year.

During the last four years (1990-1993), groundfish catch has been highest during the months of January through March and June through September, with the exception of the 1993 implementation of the pollock 'B' season delay which postponed fishing from June until mid-August (Figure 17, bottom). The mean chinook salmon bycatch rate (expressed as the average per-vessel rate in number of chinook salmon per metric ton of catch) is highest during the periods January through April, and October through December (Figure 18, bottom). The highest proportion of chinook salmon were bycaught during the first four months of any of these four years (Figure 18, top). The mean bycatch rate for "other" salmon is highest between July and October, which corresponds to the period of highest percentages of annual bycatch (Figure 16).

Spatially, "other" salmon bycatch tends to be highest south of 57° N latitude and east of 168° W longitude, whereas chinook salmon bycatch tends to be more widely distributed, to include the area along the 200 m depth contour, which extends to the north and west. The spatial distribution of salmon bycatch from observed hauls, over the period 1990 through 1993, is presented graphically in Figures 19 - 26, for both "other" and chinook salmon. "Other" salmon bycatch tends to be highest in the portion of the BSAI near Unimak Island and the "horseshoe", and extending along the BSAI shelf to the north and east of the 200 m contour (roughly in the vicinity of the CVOA and NMFS management area 517).

The general location of fishing effort during the period 1990 through 1993, and the locations of hauls with high bycatch of "other" salmon (e.g., 50 or more "other" salmon in a haul) are presented in Figures 27 - 34. The hauls containing 50 or more "other" salmon represented 43%, 54%, 63%, and 82% of the total "other" salmon bycatch observed in 1990, 1991, 1992 and 1993, respectively. Although fishing effort was broadly distributed on the shelf and along the 200 m contour, especially prior to 1993, "other" salmon bycatch consistently appears within the area on the shelf and along the 200 m contour between the Pribilof Islands and Unimak Island. This area is roughly included within the boundaries of the CVOA.

As a general observation, bycatch of "other" salmon can apparently occur sporadically along the extent of the 200 m contour, especially during the second half of the year. However, although spatial

analysis of the "other" salmon bycatch data does not appear to indicate precisely defined small areas which could be closed under a hot-spot authority, by far the majority of "other" salmon bycatch is concentrated in the area of the "horseshoe", and above Unimak Island on the shelf, south of 57° N latitude and east of 168° W longitude.

BYCATCH IN 1994:

The Council took emergency action in April 1994 to impose ER restrictions on "other" salmon bycatch during the pollock 'B' season of 1994 as a means of controlling "other" salmon bycatch in the Bering Sea. The option chosen under the Emergency Rule was to close 5 blocks in the CVOA (Option 7) after a cap of 42,000 "other" salmon had been taken in the CVOA. As a result of the action, the 5 designated blocks were closed to all trawling after the first week of the 'B' season fishery.

All salmon are currently required to be retained onboard a vessel until the salmon have been counted and sampled by an observer. The actual counts of salmon taken by trawl vessels are being accounted for by NMFS in addition to expanded estimates of salmon bycatch as had been made previously. In reporting actual salmon counts, NMFS has also provided a "reliability code" to quantify the accuracy of the bycatch accounting. The salmon counts are classified by the following codes: '1' if an observer actually counted each fish; '2' if the crew or others did much of the counting but were verified by an observer; '3' if the crew did most of the counting and the observer had little contact with the counts; and '4' if the counts were made by the crew and the observer can make no judgement on the reliability of the data. The following is a table of actual counts during the 'B' season by reliability code as of 3/8/95 :

Reliability Code	1	2	3	4
Actual Count of Salmon (as of 3/8/95)	13,718	20,912	3,833	1,353

TOTAL: 39,816 "other" salmon

Table 1 provides information on "other" salmon bycatch for the years 1992 - 1994 for the total Bering Sea and for the "B" season. The amounts given for 1994 are projected to the end of the season based on bycatch rates of actual counts of "other" salmon. Using the method of expanding bycatch counts and samples to unobserved vessels, as had been done in previous years, an estimated 24,343 "other" salmon had been bycaught in the Bering Sea prior to the "B" season. An estimated 39,816 "other" salmon were taken in the CVOA, and 9,234 outside of the CVOA by the completion of the "B" season. A count of 8,723 "other" salmon had been taken within the 5 blocks defined in the ER (Option 7 in this document) prior to the closure on 8/20/94.

The bycatch rate of "other" salmon within the 5 blocks prior to the ER closure this year was 1.12 salmon/mt. The bycatch rate for the entire CVOA which includes the 5 blocks was 0.35 salmon/mt, and the bycatch rate outside of the CVOA was 0.03 salmon/mt. In 1994, the 5 blocks defined an area with a high "other" salmon bycatch rate. It is likely that continued fishing in these blocks would have lead to higher bycatch rates than those seen after the closure.

The NMFS Bulletin Board also provides expanded estimates of "other" salmon bycatch as had been calculated and provided in the past. As of 9/10/94, 89,007 "other" salmon are estimated to have been taken in the various trawl fisheries using previous estimation methods. The cumulative bycatch by week in the Bering Sea is provided in Figure 35 which compares the estimated cumulative bycatch in 1993 with that estimated to date in 1994. It is apparent that the initial number of salmon

in 1993 with that estimated to date in 1994. It is apparent that the initial number of salmon estimated in the first week of the 'B' season was similar in both years, but that the rate of bycatch was reduced in 1994 following the closure of the 5 blocks in the CVOA. It is difficult to determine whether the reduced weekly catch of "other" salmon was due to the closure, or would have occurred without the closure as well, but given the high bycatch rates within the 5 blocks, it is likely that the 5 block closure had the desired effect of reducing overall "other" salmon bycatch.

WESTERN ALASKA CHUM CATCH IN OTHER FISHERIES

In addition to chum salmon bycaught in trawl fisheries and caught in directed chum salmon fisheries as reported above, chum salmon are also caught in mixed stock directed salmon fisheries. In Alaska, the principal salmon fishery which takes chum salmon possibly destined for Western Alaska,is the June fishery in the South Unimak Island and Shumagin Islands area. This fishery is primarily for sockeye salmon which are destined for Bristol Bay, however, because of the broad mixture of fish available in that location during June, salmon of all species are taken by gill nets and seiners.

Chum salmon, some of which are destined for Western Alaskan systems are among the salmon taken, in order to ensure that the impact on Western Alaskan chum salmon is not detrimental, there is a cap imposed on the number of chum salmon which can be taken in the fishery. Although variable depending on the year, the chum cap in the South Unimak and Shumagin Islands June salmon fishery was 700,000 chum salmon in 1994. The annual number of chum salmon taken in this fishery is provided in Figure 35a and has ranged between 351,000 and 1.1 million fish.

1.3.6 Status of Chum Salmon Stocks in Western Alaska

Western Alaska chum salmon returns had been projected to be well below average for 1993. In anticipation of the poor returns in 1993, the Joint United States/Canada Yukon River Technical Committee reported the following in February 1993:

> "Yukon River summer chum salmon return primarily as 4-year-old fish, although substantial numbers of 5-year-old fish occur in some years. The return of 4-year-old fish in 1993 depends upon production from the 1989 brood year and survival of the resulting cohort. Although the Anvik River summer chum escapement objective of >500,000 fish was achieved in 1989... it appears that escapements of non-Anvik summer chum stocks were below average in 1989, continuing a trend of lower than desired escapement in non-Anvik stocks in recent years. Therefore, a below average return of 4-year-old fish is anticipated from the 1989 brood year. Additionally, because of the poor return from the 1988 brood year in 1992 the 5-year-old component of the run in 1993 is also expected to be below average." (Source: YUKON RIVER JOINT TECHNICAL COMMITTEE REPORT, prepared by the Joint United States/Canada Yukon River Technical Committee. pp. 12. February 24-25, 1993. Anchorage, Alaska.)

In the same report, fall Yukon River system chum returns in 1993 were also projected, "... to be lower than normal."

The projected poor returns materialized in 1993. Low chum salmon returns on the Yukon River caused all but the earliest commercial fisheries for summer run chums to be closed, and did not allow the commercial fisheries for fall chums to be opened at all. All catches were therefore well below the lowest guideline harvest levels for all Yukon River districts (Table 2). Minimum escapement goals for summer and fall run chum salmon on the Yukon River were met on only a few tributaries:

> Escapement objectives were met in only one summer chum salmon stream throughout the entire drainage in 1993. The Anvik River escapement of 517,409 fish was 4% above the minimum escapement objective of 500,000 fish (ADF&G 1994a, p.19).
>
> Overall, fall chum salmon escapements were below average in 1993 with objectives being achieved in only one area.(ADF&G 1994a, p.20).

Although 1993 returns were extremely low in many systems, the 1994 returns have been average or above average in most systems. However, in spite of these better returns in 1994, low catches and returns might be expected into the near future for the Yukon and Kuskokwim Rivers because of poor survival in the parent years. In a report to the Board of Fisheries in February 1994, an ADF&G report stated the following concerning the Yukon River:

> During the 1980's, there was concern for the health of fall chum salmon stocks because spawning escapements were below objective levels from 1982 through 1984. Additional regulatory restrictions adopted by the Board of Fisheries in 1983 and 1986 resulted in generally improved spawning escapements during the late 1980's. However, spawning populations in the Toklat River, Fishing Branch River, and the Yukon River mainstem in Canada have shown less improvement than other spawning areas. Therefore, over the next four year cycle, a continued reduction in fall chum harvests is believed to be necessary (ADF&G 1994a, p.20).

and the following concerning the Kuskokwim River in 1993 and beyond:

> Parent year escapements were excellent in both the 1988 and 1989 brood years. The poor return of 5 year old chum salmon in 1993 is coincidental with the record cold temperatures in January and February of 1989. We suspect that a freeze-down during the 1988-89 winter caused increased mortality of chum salmon eggs resulting in the weak return of 5 year old fish in 1993. The poor survival of 4 year old chum salmon was unexpected and unexplained. The cause of the much poorer survival of Aniak River chum salmon, when compared to the rest of the drainage is also unknown. The two weak years back to back signals poor returns in 1996 through 1998 even with normal survival. The management of the mixed stock fishery in Districts 1 and 2 will be a challenge if the rest of the Kuskokwim drainage has normal survival (Francisco et al. 1994 pp.13-14).

The possible impacts chum salmon bycatch in the trawl fisheries might have had on especially the 1993 run failures is unknown but it is probable that they were small. It should be noted that most returns occurred prior to the 1993 pollock 'B' season bycatch interceptions. Currently the pollock "B" season begins on August 15, The estimated midpoint of the Fall Yukon River run of chum salmon in 1993 was August 8, and the midpoint for the summer Yukon River run was June 27 (ADF&G 1994a).

Neither brood years contributing to low subsequent returns, such as the 1988 and 1989 Yukon chum runs which comprised the brood years for the 1992 and 1993 chum runs, nor years which contributed to healthy returns appear to be associated with high "other" salmon bycatches in the BSAI groundfish fisheries from the same years. This suggests that, while bycatch losses of any chums destined for Western Alaska rivers would have diminished already lower than average run size, bycatches of "other" salmon in the 1993 pollock 'B' season are not likely to be the principal cause of the 1993 A-Y-K chum salmon declines.

1.3.7 Socioeconomic Values

COMMERCIAL:

The value of chum salmon measured at the ex-vessel level, or the level paid to fishers, varies with market values and availability. The catch of chum salmon, especially in the A-Y-K Region is often both for commercial and subsistence uses and, for example, fish caught in a commercial opening may be kept for subsistence. Because of poor runs there may be regulatory restrictions which apply to commercial fishing but not to subsistence. The subsistence values are not easily quantified as explained below. Chum salmon roe can be much more valuable than the meat. Depending on location, the roe is purchased from fishers separately or the salmon is purchased whole with the roe being extracted later by processors. The following table provides the 5 year average exvessel value for chum salmon from various Western Alaskan locations (Source: 1993 ADF&G Board of Fisheries and Area Management Reports):

Location/Fishery	Average exvessel value, 1988 - 1992
Kotzebue Sound	$920,975
Lower Yukon Summer Chum	$1,821,709
Upper Yukon Summer Chum	$850,020
Yukon Fall Chum	$558,164
Kuskokwim Area	$1,646,445
Bristol Bay	$2,273,000

SUBSISTENCE:

The importance of chum salmon to the Yup'ik Eskimos and Athabaskan Indians of Western and Interior Alaska is very similar to that for chinook salmon except that chum salmon are also an important food item for sled dogs.

<u>The Importance of Salmon in the Traditional Cultures and Socioeconomic Systems of the Yup'ik Eskimos and Athabaskan Indians of Western and Interior Alaska</u>

Chinook and chum salmon are one of the major food items of the Yup'ik Eskimo and Athabaskan Indians of Western and Interior Alaska. Chinook and chum salmon play an important role in supporting the indigenous cultures and mixed, subsistence-cash socioeconomic systems of the Yup'ik and Athabaskan peoples in Alaska. As is described below, subsistence activities, especially harvesting, processing, sharing, and using chinook and chum salmon, provide a number of social, cultural, and economic values to indigenous peoples of Western and Interior Alaska.

The drainages of the Yukon River, Kuskokwim River, and Bristol Bay area are the ancestral homes of several indigenous groups who use chum and chinook salmon, as listed in Tables 3 and 4 with their historic cultural affiliations. These groups include Central Yup'ik Eskimo, Dena'ina Athabaskan, Gwich'in Athabaskan, Han Athabaskan, Holikachuk Athabaskan, Ingalik Athabaskan, Koyukon Athabaskan, Tanana Athabaskan, and a few Inupiat Eskimo. These cultural groups resided in about 95 rural communities in 1990, according to the U.S. Census, with about 21,807 Alaska Natives. In addition, there resided about 6,324 non-Natives in rural communities of this area, who are persons primarily from Euro-American cultural traditions.(Table 5).

Currently, most Alaska Native villages in the drainages of the Yukon River, Kuskokwim River, and Bristol Bay area have traditional tribal governments which are organized under the Indian

Reorganization Act and recognized by the United States government. The tribal governments are further organized under regional non-profit organizations, listed in Tables 3 and 4.

The peoples of the Yukon, Kuskokwim, and Bristol Bay area continue to maintain traditional cultures and mixed, subsistence-market economies, modified in particular aspects by the incorporation of certain features of the outside Euro-American culture and market economy. The local economy of this area has been called a "mixed, subsistence-market economy" (Wolfe 1984, Wolfe and Walker 1987). The mixed, subsistence-market economy is a system of production and distribution of goods and services that supports the rural communities of the area. There are three components to the economy: (1) traditional subsistence fishing and hunting; (2) monetary income earned through sales of fish and furs produced and marketed through local, small-scale commercial fishing and fur trapping industries; and (3) monetary income earned through limited, local wage employment, usually through public sector grants. The subsistence sector of the local economy is organized under a "domestic mode of production", meaning that traditional kinship groups provide the primary social organization of subsistence food production (in contrast to the non-kinship economic firms of industrial-capitalism) (Wolfe et al. 1984).

Wild Food Harvests

Wild food production is one major component of the mixed, subsistence-market economies of the Yukon-Kuskokwim-Bristol Bay area. The indigenous societies of the drainages of the Yukon River, Kuskokwim River, and Bristol Bay area are still heavily reliant on subsistence fishing and hunting for survival. In Alaska Native villages, daily life is commonly organized around traditional fishing, hunting, gathering, and trapping activities for local uses, including direct family consumption and customary distribution and sharing. Subsistence harvests of wild foods in the area are large, as shown in Table 6, with many communities harvesting between 400 to 900 lbs of wild resources per person each year. This level of wild food production contains more than the communities' yearly protein requirements. By comparison, Americans in the continental United States purchase an estimated 1,370 lbs of food annually, of which 220 lbs are meat, fish, and poultry. In addition to the subsistence foods, communities in the Yukon-Kuskokwim-Bristol Bay area import certain food products, especially carbohydrates such as flours and sugars which are high in kilocalories.

Chinook and chum salmon are one of the major subsistence food products produced within the Alaska Native communities of the Yukon, Kuskokwim, and Bristol Bay areas, as shown in Tables 7 to 9. Chinook salmon is highly valued as a food fish for human consumption. A large, bright fish with firm, rich flesh, chinook are excellent for drying and smoking. Families commonly establish fish camps during summer to fish for chinook salmon. Some camps have been continuously occupied for generations. Chum salmon are usually graded with the bright fish going to human consumption, and the rest generally being processed for consumption by dog teams. Fish are caught using set gill nets, drift gill nets, or fish wheels, depending upon the community. The fish are processed with a traditional division of labor, typically with the men harvesting and the women processing salmon commonly are cut, air dried on outdoor racks, and smoked in family smokehouses, using labor-intensive methods.

Commercial Fisheries

A second component of the local mixed, subsistence-market economy are small-scale fisheries and fur trapping for commercial sale on export markets. The development of local commercial salmon fisheries has created the potential for a more stable source of cash income for communities. These fisheries have produced a small, potentially sustainable source of income to the region (Wolfe 1984). Historically, fur trapping of beaver, mink, land otter, white fox, and red fox for sale has contributed

income to the local economy. During recent decades, unstable world market prices for furs have meant this activity contributes at most only about 10 percent of the total earned monetary income by families in the Yukon, Kuskokwim, and Bristol Bay area.

Wage Employment

Wage employment, a third component of the local, mixed economy, is limited in the rural communities of the Yukon, Kuskokwim, and Bristol Bay area. The primary source of wage employment is in state, federal, and local government-funded services, providing a few local wage jobs in schools and municipal services. In general, there is no private business sector in the communities providing wage employment. State and federal capital improvement projects have provided temporary local wage employment in construction of housing and schools during Alaska's oil-boom period from 1978 to 1986, but this source of employment is disappearing with falling state oil revenues.

The market-wage component of the mixed economy historically has not been strong in many of the area's communities. According to the 1990 U.S. Census, median household incomes commonly are below $20,000. As a comparison, Anchorage had a median household income of $43,946 in 1990, and Fairbanks had a median household income of $32,033 (Table 5). In addition to low incomes, the purchasing power of monetary incomes in these rural areas is eroded by a high cost of imported items.

Because of the low incomes, most of the area's communities could not sustain themselves without subsistence fishing and hunting. Historically, the communities' most secure economic adaptation is to participate in a traditional mixed economy, combining subsistence fishing and hunting with cash earnings from limited wage employment and commercial fishing. The money generated in the commercial-wage sector of the economy enables families to capitalize in the subsistence sector, producing a substantial portion of the local food supply. To correctly understand the importance of subsistence resources like salmon, one must understand the importance of wild resources in the sustained functioning of the local, mixed, subsistence-market economy.

Values of Subsistence

Monetary measures are not designed to adequately account for many values derived from traditional, indigenous cultural systems of the Central Yup'ik Eskimo and Athabaskan Indians. The values derived from the indigenous culture and economy are traditional ones, embedded within traditional systems of kinship, beliefs, customs, and ritual which are substantially different from those of Euro-American systems.

Ascribing a value to subsistence salmon fishing within Alaska Native communities is difficult because of the markedly different cultural and economic contexts of the subsistence use. From the point of view of the indigenous culture, chinook and chum salmon have great value because of salmon's central position in the traditional economy, culture, and social system. Some of these values are listed below.

Food Supply:

As indicated above, subsistence salmon fishing provides a substantial part of the food supply in the Yukon-Kuskokwim-Bristol Bay area. For most rural communities, subsistence harvests contain over 100 percent of the protein requirements of the population (about 44 g protein per person per day). Chinook and chum salmon are some of the main food species in most communities. Salmon plays

a central nutritional role in the local economies because of its large volume, annual reliability, and inexpensive procurement costs.

Economic Security to Families:

Subsistence salmon fishing provides a type of long-term economic security to families which wage employment does not provide. For many communities, subsistence food production is more reliable from year to year than income from wage employment. Subsistence serves as an economic safety net for families during regular, periodic downturns in the local wage sector or personal family finances. It provides security and stability to the local subsistence economy in ways that other resources cannot.

Social Security to Dependents:

Subsistence serves as a form of social security for the aged and the dependent in villages. Subsistence foods are shared to the elderly and people unable to fish and hunt themselves as a form of traditional social security (Wolfe 1987). The high value of salmon is related to its importance in the networks of non-market distribution and exchange of subsistence products between households in the community. Households which cannot fish and hunt for themselves due to age or other personal circumstances receive subsistence foods from productive households, usually along lines of kinship or traditional exchange relations. Negative impacts on subsistence production would compromise these traditional social support networks, especially for the elderly and unmarried mothers with dependent children. Because of the large volume produced, chinook salmon is one of the major food products flowing through these traditional distribution and exchange networks.

Transmission of Knowledge:

Subsistence salmon fishing benefits the continued transmission of traditional cultural knowledge, skills, and beliefs between older and younger generations. Subsistence activities teach group responsibility and leadership which have value in other social areas. The intergenerational transmission of knowledge promotes continuity and social order in the community.

Functioning Family Groups:

Subsistence salmon fishing benefits the functioning of extended family groups which are responsible for subsistence activities. Subsistence activities provide meaningful, productive work roles to men, women, and children in the community. Subsistence fishing and hunting are more than mere occupations in indigenous Yup'ik and Athabaskan cultures, they are activities central to the functioning of family and community, and central to the personal psychological integrity of the individual. Alaska Natives as a people traditionally define themselves in terms of mutual social relationships with kinship groups and spiritual relationships with the natural world. The traditional work tasks of catching and processing subsistence foods for the kin group are primary social roles of men and women. For instance, the Yup'ik word for "man" (*angun*, "human male"), literally means "something that chases something for food" (from the root *angu-*, "to catch after chasing", and the lexical stem *-n*, "instrument") (Jacobson 1984:500). A *nukalpiaq*, "a young man in his prime", also means "a good hunter and provider" (Jacobson 1984:268). Thus hunting and fishing are more than just character-defining occupations for men, they help to define gender itself. Similarly, processing subsistence foods is a primary social role for women in Yup'ik and Athabaskan culture, defining her important position in the social order. Once the subsistence kill is turned over to the woman for processing, she typically owns and controls the subsistence product. The woman determines its disposition, and can keep or give it away as she chooses.

The high value of salmon in the Yukon, Kuskokwim, and Bristol Bay area is due in part to its central position in the functioning of families in the traditional annual cycle of subsistence activities. Production of salmon is one of the major social functions of extended family groups in the area. Because of the traditional domestic mode of production for salmon, negative impacts on subsistence salmon production have direct negative impacts on the functioning of family groups. The disruption of salmon production activities would directly disrupt primary social functions of families.

Self-Determination:

Subsistence salmon fishing provides a means for local self-determination in rural communities. Subsistence fishing and processing activities are organized locally and draw on local knowledge and skills. Subsistence is an area of life where local communities can support themselves in meaningful, productive, and valuable work. It reinforces confidence in the local group's ability to achieve a satisfying way of life.

Reduced Social Problems:

Because subsistence salmon fishing creates meaningful livelihoods for Alaska Natives, it probably helps to decrease rates of social pathologies in rural communities which have resulted from rapid rates of culture change. Social pathologies which are problems in rural areas include chronic substance abuse, domestic violence, suicides, homicides, accidents, and destructive anomie. Rural communities have sought to halt these processes through a continuance of traditional ways of living, including subsistence fishing and hunting.

Customary Foods:

Food customs differ in Alaska's rural areas, and rural diets are commonly built around staple traditional food products such as dried salmon. Alaska Natives and other long-term rural residents state they have a need to eat traditional foods to which they have become accustomed. These types of foods commonly cannot be imported from the continental United States.

Cultural Survival:

Alaska Native groups insist that without traditional fishing and hunting activities, they would disappear as culturally-distinctive peoples (cf., Berger 1985). Harvesting wild resources expresses and reinforces special relationships among Alaska Native peoples and the land, relationships with roots stretching back many centuries. Subsistence instills group identity and purpose, which are essential to well-being of individuals, families, and communities.

Ceremonial Exchange:

Subsistence foods are primary items for ritualized exchange relations between families. Reciprocal and ceremonial exchange relations are primary social mechanisms for unifying communities in Central Yup'ik and Athabaskan Indian cultures, and for expressing spiritual relationships between humans and animals. There are a variety of ceremonial contexts through which the exchange of food expresses spiritual values, including funeral potlatches and winter ceremonials. For instance, the first subsistence activities of young Yup'ik children are ritually celebrated with feasts (*kalukaq*, or *nerevkarin*). Subsistence foods (raw and cooked) typically are distributed in the name of the young child among the guests, which include unrelated kin groups from the larger community. These ceremonies involve spiritual and reproductive symbolisms, for the sharing of the first fruit is to help the child's future hunting and fishing success and marriage prospects, which in turn supports the

community's future reproductive success (Fienup-Riordan 1984). They also express on-going mutual obligations between humans and the spirit owners of the animals, by properly using the subsistence product, so that the animals will continue to offer themselves to humans in the future. Without subsistence foods, the rites linking humans and animals in the traditional cosmology would not be possible, and the future of the human race jeopardized.

Clearly, subsistence salmon and other subsistence resources provide a variety of values to the indigenous Central Yup'ik and Athabaskan cultures which go beyond their nutritional and economic values. Without these subsistence activities and uses, the indigenous cultures could not survive in their traditional forms. It is impossible to put an economic value to the survival of traditional cultures like those of the Central Yup'ik and Athabaskan Indians in Alaska. There is growing international concern that the survival of indigenous, culturally diverse groups should be a central social goal in relations between national and ethnic groups. That is, the existence of culturally diverse, indigenous groups is a desirable social end (and in fact, a social right of the indigenous group). The loss of a traditional culture is usually irreversible. And the lost values of that culture is a loss to the world.

Given this framework of values, management of Bering Sea salmon stocks should be done with great awareness of the cultural survival of the indigenous Yup'ik Eskimo and Athabaskan Indian cultural groups. Management of salmon stocks should be carefully done in ways that are compatible with the continued cultural survival of the Yup'ik and Athabaskan people and their culture.

Because of the difficulty in estimating a value for chum salmon in the subsistence fishery, however, and because subsistence and commercial values are not directly comparable, the value of a subsistence caught chum salmon was not included in this analysis.

The following anticipated effects from a shortfall in chum salmon availability was excerpted from an ADF&G, Division of Subsistence presentation to the Alaska Board of Fisheries during a special meeting on Western Alaska Chum Salmon, December 1-4, 1993 (ADF&G 1993b):

POTENTIAL EFFECTS OF CHUM SHORTAGES

We will end this report with a few comments about potential effects of chum salmon shortages (*sic*) in the A-Y-K area.

It is difficult to assess the effects of the 1993 chum shortfall at this time. The post-season subsistence salmon harvest surveys for the 1993 season have not been completed. Post-season household surveys along the Yukon River were still underway during the week of November 15, and mailed permit returns are not required until the end of the calendar year.

At this point, only a few general assessments of potential effects may be advanced, based on our observations and the harvest information collected on previous years.

1. Chum harvests for subsistence are largest on the Yukon, Kuskokwim, and Norton Sound areas; because of this, it is anticipated that chum shortfalls in subsistence and commercial fisheries will be felt to a greater extent in those areas, if they occur, than areas such as Bristol Bay and the Alaska Peninsula. Potential short-term effects on households in the areas might include:

    a. reduced supplies of preferred wild foods

    b. reduced household incomes

c. disruptions of various types, such as:

(1) disruptions of seasonal fish camp activities (on the Yukon, some families closed up camp operations because of uncertainties of openings),

(2) disruptions in the course of subsistence activities during the remainder of the year, and

(3) disruptions of having to respond to unusual regulatory crisis management situations (emergency conferences, group decision-making, stresses of weighing personal risks about fishing or not fishing, and so forth).

2. It is anticipated that shortfalls of chum in the Yukon, Kuskokwim, and Norton Sound areas, when they occur, will lead to greater use of other wild resources in the short term. It is likely that subsistence harvests may increase for whitefish, pike, burbot, sheefish, hare, grouse, ptarmigan, moose, and furbearers (whose furs are sold for cash, and whose carcasses used for dog food, trapping bait, and sometimes for food).

3. It is anticipated that sharing and trade of wild foods between households will be affected by shortages. Some households will increase sharing and trade to make up for shortfalls in food, when they occur; however, some resources may be in short supply, which may reduce sharing.

4. One may anticipate that for many households, shortages in food and income because of poor salmon fishing during summer, may appear later during the seasonal cycle, perhaps during late winter to early spring.

5. During years of poor chum harvests, it is anticipated that some households may reduce their number of sled dogs, and the size of their dog teams, by culling, giving away, or trading dogs. Some households which can afford to do so may purchase greater amounts of commercial dog feed to support sled dogs; however, this is not an option for the greater proportion of households with limited monetary incomes.

6. Finally, more restrictive management regimes commonly are a response to temporary fish shortages. Less fishing time, area closures, gear restrictions, permit systems, harvest quotas, and restrictions on use are management tools which have been instituted in other areas of the state for subsistence fisheries. Restrictive regulations to solve unusual temporary shortfalls, sometimes become permanent features of a region's fisheries management regime. Compared with other regions of the state, the previous subsistence salmon regulations of the A-Y-K area have been relatively less restrictive. Families prefer relatively simple management systems that provide for their traditional subsistence uses. The institution of more complex and more restrictive management regimes has the potential of creating significant economic and social disruptions in the A-Y-K area.

1.3.8 Oceanography

As can be seen in Figure 34, which shows the location of all hauls containing 50 or more "other" salmon in 1993, the distribution of "other" salmon appears to approximate a circle or oval which extends from Unimak Island northwest to the Pribilof Islands and remains on the shelf side of the 200 m contour. Although requiring further exploration, there is a possible physical explanation for this pattern in the distribution of "other" salmon. Ocean currents entering the BSAI through Unimak pass tend to flow north both along the 200 m isobath (outer front) and the 100 m isobath (middle front) as discrete fronts first described by Coachman et al. 1980 and reproduced in McRoy et al. 1985 (Figure 36). The pattern of "other" salmon distribution roughly corresponds to the outer domain, or

the area between the middle front and the outer front. The formation of the middle and outer fronts provides for an area of lateral mixing of BSAI basin water with shelf water in the outer domain (McRoy et al. 1985). As described in McRoy et al. 1985 (Figure 37), the outer domain is an area of primary production for the pelagic community which includes pollock. It appears that between July and October, the outer domain is also important to "other" salmon. A possible alternative area of protection for "other" salmon might be the area of the outer domain bounded to the south and west by the 200 m contour and to the north and east by the 100 m contour.

1.4 Analysis of the options

The following analysis presents the proportion of catch and bycatch taken from each of the seven major closure area options during 1990 - 1993. Although statistics from 1990, 1991, and 1992 are important in indicating trends in "other" salmon bycatch and potential impacts to fishing fleets, 1993 is the year in which fisheries management options and the distribution of fishing effort are likely to be similar to the 1994 and future fisheries. It should be noted that it is primarily the observations from a single year (1993) which have been used to select relevant areas for hot-spot closure authority.

Catch and bycatch numbers were expressed as proportions of annual totals in order to provide year-to-year comparison (refer to Table 10). It should be noted that several of the defined areas overlap and contain portions of the areas in other alternatives. As Figure 38 (top) indicates, the highest percentage of the total annual weight of observed groundfish catch (36% - 57%) was taken within 15 miles of the 200 m contour, in the two blocks to the north of Unimak Island, and the "horseshoe" (Option 2). Catch within the CVOA (Option 3) has increased annually to account for more than 51% of the total observed groundfish catch in 1993, and catch in Area 517 (Option 4) approximately doubled from previous levels to account for roughly 51% of the total annual groundfish catch from the BSAI in 1993. Of the options comprised of selected blocks with high "other" salmon bycatch, annual groundfish catch within these areas in 1993 approximately doubled from previously observed percentages to account for roughly 27%, 16% and 23% of the total annual groundfish catch from the 9 blocks, 7 blocks and 5 blocks (Options 5 - 7), respectively. Graphs of the number of hauls, by area, were nearly identical to the patterns indicated for groundfish catch.

"Other" salmon bycatch is significant between the months of July and October. Therefore, the effort and catch from within this period was compared with the effort and catch from the entire year (Table 10). The contour and Unimak Island blocks (Option 2) during this period accounted for nearly 30% of the annual groundfish catch in 1993, up more than 10% from previous levels during 1990 through 1992 (Figure 38, bottom). The percentage of CVOA (Option 3) catch during this period jumped from approximately 10% of the annual total groundfish catch to more than 25% of the catch; and the catch in Area 517 (Option 4) approximately tripled during this period in 1993 to account for 28% of the total annual catch. The individual blocks selected for closure under Options 5, 6 and 7, represented a very small percentage of the total annual groundfish catch during this period until 1993 when they accounted for between 7% and 10% of the total annual catch.

The area that most consistently accounted for "other" salmon bycatch from year to year was the CVOA (Option 3), which represented between 78% and 82% of the total annual "other" salmon intercepted in the BSAI since 1990 (Figure 39, top). The contour buffer and two Unimak Island blocks (Option 2), much of which lies within the CVOA, accounted for 84% and 86% of the total annual "other" salmon catch in 1991 and 1992, respectively. However, in 1993, only 55% of the total annual "other" salmon bycatch came from this area. "Other" salmon bycatch in Area 517 (Option 4) has ranged between 27% and 87% of the annual total. Of the three selected block configurations, the 9 blocks (Option 5) accounted for between 39% and 44% of the total annual "other" salmon bycatch prior to 1993 (in spite of small groundfish catches from these blocks), and 67% of the total

annual "other" salmon bycatch came from this area in 1993. Because almost all of the "other" salmon bycatch occurs between the months of July and October, the figure comparing the bycatch during this period (Figure 39, bottom) to the entire year is nearly identical to the figure above for the annual catch within areas.

The bycatch of "other" salmon is a function of both the availability of "other" salmon, as well as intensity of effort in the areas within which "other" salmon appear. The high bycatch of "other" salmon in 1993 was primarily due either to an increased number of salmon available, or an increased effort at the time and areas in which "other" salmon occur. In 1990, effort was fairly constant throughout the year, and chum salmon bycatch was low. It is possible that the number of "other" salmon available in the BSAI was much lower than that available in 1993. However, fishing effort in 1990 was largely to the north (e.g. 25% of the groundfish catch came from the CVOA and 18% from Area 517, Figure 38, top) and almost no catch was taken from the 9 blocks, 7 blocks or 5 blocks (Options 5, 6 and 7). Yet in spite of the very low groundfish catch reported from these block options, 39%, 14%, and 34% of the "other" salmon bycatch came from the 9 blocks, 7 blocks, and 5 blocks in 1990, respectively (Figure 39). A similar pattern was observed in the 1991 and 1992 fisheries.

As discussed above, in 1993 there was a shift of effort to the south in the region of the CVOA and Area 517 (Figure 33). Of the alternatives considered, the contour buffer accounted for the smallest number and percentage of "other" salmon encountered in 1993 (roughly 32% of the "other" salmon bycaught between July and October). Only roughly 24% of the "other" salmon bycaught within the contour buffer (or roughly 9% of all "other" salmon bycaught in the BSAI between July and October) were in the portion of the contour outside of the CVOA. The majority of "other" salmon caught within the vicinity of the 200 m contour are taken south of 56° N latitude and east of 168° W longitude. Because the majority of "other" salmon are taken within the CVOA, the northwest extent of the CVOA was chosen as the northwest boundary of the contour buffer under Sub-options 1b and 2b.

In order to more closely examine the portion of the contour buffer which lies within the CVOA, the catch, number of hauls, and bycatch of chinook and "other" salmon were summed separately for the following exclusive areas: 1) the portion of the contour buffer which lies within the CVOA; 2) the two Unimak Island blocks; 3) the remainder of the CVOA; 4) the contour buffer which lies outside of the CVOA; and 5) the remainder of the BSAI. Figures 40 - 42 and Table 11 provide the percentage catch or bycatch that occurred within each of the above areas during the years 1990 -1993. It should be noted that whereas the July - October percentages discussed above were the proportion of catch or bycatch during that period to the total annual catch or bycatch, the percentages in Figures 40 - 42 and Table 11 for the months July - October are the proportion of catch or bycatch within the exclusive area for that period alone, and not for the entire year.

The increase in the percentage of hauls and groundfish catch in the Unimak Island blocks and the CVOA as a whole (e.g. the sum of the contour, the Unimak blocks and the remainder of the CVOA, but excluding the portion of the contour outside the CVOA and excluding the rest of the BSAI) are apparent in Figure 40. During the months of July through October in 1990, 1991, and 1992, groundfish effort and catch had been concentrated within the remainder of the BSAI (68.3%, 50.2% and 43.7%, respectively), and the portion of the contour buffer which lies outside of the CVOA (7.0%, 30.3%, and 23.1%, respectively. Figure 41 and Table 11). The shift of effort and increased catch in all portions of the CVOA was apparent in the 1993 groundfish fisheries.

As can be seen in Figure 42 (top), the area within the CVOA has consistently accounted for approximately 80% of the total "other" salmon bycatch. In 1993, "other" salmon bycatch was

approximately six times that encountered in 1991 or 1992. However, the percentage of "other" salmon bycatch inside and outside the CVOA remained constant in spite of the increase in catch and effort inside the CVOA. This could either indicate an overall increase in the availability of "other" salmon, or an increased availability with the time of year, since the proportion of "other" salmon encountered in September was much higher than in previous years.

The increase in effort in the portion of the CVOA outside of the contour buffer or the Unimak blocks lead to a disproportionate increase in the percentage of "other" salmon bycaught in that area when compared to the percentage of groundfish catch the area represented.

In summary, seven options and two sub-options were examined for potential closure due to "other" salmon bycatch. The relative impacts on groundfish catch and "other" salmon bycatch due to such closures have been examined by comparing the historic percentage of catch and bycatch from each of the areas. Based on historic data, it appears that high chum salmon bycatch is coincident with two recent management actions - the implementation of the CVOA; and the delay of the pollock "B" season to August 15. In order to provide another means of assessing the alternatives, the number of "other" salmon encountered for each metric ton of groundfish catch is provided in Figure 43. Figure 35 illustrates the approximate bycatch per week in 1993. High bycatch occurred consistently through the "B" season in 1993. Further analysis of the alternatives is provided in the section dealing with economics below.

1.4.1 Prohibited Species Cap for "other" salmon

Under the ER, the Council adopted a cap of 42,000 "other" salmon as a trigger for the closure of 5 blocks in the CVOA in April 1994. This cap represents 50 percent of the average number of "other" salmon bycaught in the CVOA between 1991 and 1993, with the CVOA representing 80% of the total Bering Sea bycatch of "other" salmon in any year. In 1991 or 1992 the bycatch of "other" salmon (36,000 and 39,000 fish, respectively) would not have triggered a closure of the 5 block area under this cap. In 1993, a cap triggered closure would have occurred after the first week of fishing in the CVOA, and in 1994 the cap did trigger the closure of the 5 blocks after the first week of fishing. Figure 35 provides the cumulative bycatch by week in the Bering Sea in 1993 and 1994.

Adoption of a cap to trigger a closure rather than having a closure occur according to a pre-specified date allows action to be taken only if it appears that bycatch will be a problem in that year. Prior to 1993 and 1994, the cap adopted by the Council under the ER would not have closed any fisheries.

2.0 NEPA Requirements: Environmental Impacts of the Alternatives

An environmental assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will result in a significant impact on the human environment. The environmental analysis in the EA provides the basis for this determination and must analyze the intensity or severity of the impact of an action and the significance of an action with respect to society as a whole, the affected region and interests, and the locality. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An environmental impact study (EIS) must be prepared for major Federal actions significantly affecting the human environment.

An EA must include a brief discussion of the need for the proposal, the alternatives considered, the environmental impacts of the proposed action and the alternatives, and a list of document preparers. The purpose and alternatives were discussed in Sections 1.1 and 1.2, and a list of preparers is in

Section 6.0. This section contains the discussion of the environmental impacts of the alternatives including impacts on threatened and endangered species and marine mammals.

2.1 Environmental Impacts of the Alternatives

The environmental impacts generally associated with fishery management actions are effects resulting from; 1) harvest of fish stocks which may result in changes in food availability to predators, changes in the population structure of target fish stocks, and changes in community structure; 2) changes in the physical and biological structure of the benthic environment as a result of fishing practices, e.g. effects of gear use and fish processing discards; and 3) entanglement/entrapment of non-target organisms in active or inactive fishing gear. A summary of the effects of the 1995 groundfish total allowable catch amounts on the biological environment and associated impacts on marine mammals, seabirds, and other threatened or endangered species are discussed in the final environmental assessment for the 1995 groundfish total allowable catch specifications (NMFS 1995a).

Adoption of Alternative 2 or Alternative 3, with a given "closure option", would not adversely affect the environment. Either alternative would reduce the number of "other" salmon that may be taken as bycatch during the pollock "B" season. More salmon could potentially be available to predators and reduced salmon bycatch could potentially mitigate adverse impacts of salmon bycatch on Western Alaska chum salmon stocks, to the extent that the two are causally linked. Neither alternative to the status quo would affect the TAC amounts for the groundfish fisheries. Overall fishing effort would shift out of the closed area, either for the entire year as under Alternative 2, or for just one month (August) with possible continuance once a 42,000 "other" salmon cap was reached, under Alternative 3. Fishing effort in other areas may increase to account for the inaccessible fishing grounds in the closure area.

2.2 Impacts on Endangered, Threatened or Candidate Species

Listed and candidate species that may be present in the BSAI are discussed in detail in the Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analyses (EA/RIR/IRFA) conducted on the annual total allowable catch specifications (NMFS 1995a). Species that are listed, or proposed to be listed, under the Endangered Species Act that may occur in the BSAI include the endangered fin whale (Balaenoptera physalus), sei whale (Balaenoptera borealis), humpback whale (Megaptera novaeangliae), sperm whale (Physeter catodon) and short-tailed albatross (Diomedea albatrus); the threatened Steller sea lions (Eumetopias jubatus); and the proposed as threatened spectacled eider (Somateria fischeri). Fishing activities conducted under alternatives 2 and 3 would not affect any endangered or threatened species listed under the Endangered Species Act in any manner not already considered in the informal consultation and a subsequent determination conducted regarding the impacts of the 1995 BSAI total allowable catch specifications on Steller Sea lions (January 14, 1994; February 3, 1995), the Biological Opinion and a subsequent determination on the effects of the 1995 BSAI groundfish fisheries on listed species of salmon (January 19, 1994; January 25, 1995) and the formal consultation and subsequent amendment on listed species of seabirds (U.S. Fish and Wildlife Service, February 14, 1994; February 7, 1995).

Listed species of Pacific salmon, including the Snake River sockeye salmon, fall chinook and spring/summer chinook salmon may be present in the BSAI. A Biological Opinion conducted on effects of the BSAI groundfish fisheries concluded that the continued operation of these fisheries is not likely to jeopardize the continued existence of endangered or threatened Snake River salmon species (NMFS 1994b). A determination was made that fishing activities under the 1995 BSAI and GOA groundfish catch specifications are not likely to affect listed species of salmon in amanner or

to an extent that has not already been considered in Section 7 consultations on this fishery (NMFS 1995b)

Endangered, threatened, proposed and candidate species of seabirds that may be found within the regions of the BSAI where the groundfish fisheries operate, and potential impacts of the groundfish fisheries on these species are discussed in the EA prepared for the TAC specifications. A formal consultation conducted by the U.S. Fish and Wildlife Service (USFWS) on the potential impacts of groundfish fisheries and a subsequent informal consultation on the 1994 groundfish fisheries and an amendment to the Biological Opinion on the 1995 groundfish fisheries on these species concluded that groundfish fisheries adversely affect, but do not jeopardize, the existence of the short-tailed albatross if the incidental take allowance of up to two short-tailed albatrosses per year was not exceeded (USFWS 1989, 1994, 1995). The informal consultation also concluded that groundfish fisheries were not likely to adversely affect the spectacled eider, Steller's eider, or marbled murrelet.

As with salmon and seabirds listed under the ESA, fishing activities under this proposed action are not likely to impact the threatened Steller sea lion in a manner or to an extent not previously considered in informal Section 7 consultations for 1995 groundfish fisheries (NMFS 1995c). The 10 nm annual trawl exclusion areas around Steller sea lion rookeries and the seasonal 20nm trawl exclusion areas around specified rookeries would be in place regardless of the option chosen. These create refuges where no trawling can occur in areas important for sea lion breeding and foraging.

Alternative 1, (status quo) is not expected to affect any proposed, candidate or listed seabirds in a manner not already authorized in previous consultations.

Alternatives 2 and 3 could act to protect the salmon stocks in the BSAI. A reduction in the number of salmon taken as bycatch in other fisheries is ultimately beneficial to the various salmon populations, regardless of their origin. These alternatives are not likely to adversely impact endangered, threatened, or candidate species.

2.3 Impacts on Marine Mammals

Marine mammals not listed under the Endangered Species Act that may be present in the GOA and BSAI include cetaceans, [minke whale (Balaenoptera acutorostrata), killer whale (Orcinus orca), Dall's porpoise (Phocoenoides dalli), harbor porpoise (Phocoena phocoena), Pacific white-sided dolphin (Lagenorhynchus obliquidens), and the beaked whales (e.g. Berardius bairdii and Mesoplodon spp.)] as well as pinnipeds [northern fur seals (Callorhinus ursinus), and Pacific harbor seals (Phoca vitulina)] and the sea otter (Enhydra lutris).

Either alternative to the status quo could potentially benefit marine mammals by preserving available salmon resources that otherwise may have been removed from the food chain. Potential closures as outlined among the seven options and two sub-options, to all trawling for some portion of the fishing year could also be beneficial to marine mammals who use this area for foraging.

2.4 Coastal Zone Management Act

Implementation of either alternative to the status quo would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of Section 30(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

2.5 Conclusions or Findings of No Significant Impact

Adoption of either Alternative 2 or Alternative 3 would not likely affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act of its implementing regulations.

3.0 REGULATORY IMPACT REVIEW:ECONOMIC AND SOCIOECONOMIC IMPACTS OF THE ALTERNATIVES

This section provides information about the economic and socioeconomic impacts of the alternatives including identification of the individuals or groups that may be affected by the action, the nature of these impacts, quantification of the economic impacts if possible, and discussion of the trade-offs between qualitative and quantitative benefits and costs.

The requirements for all regulatory actions specified in Executive Order (E.O.) 12866 are summarized in the following statement from the Order:

> In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

This section also addresses the requirements of both E.O. 12866 and the Regulatory Flexibility Act to provide adequate information to determine whether an action is "significant" under E.O. 12866 or will result in "significant" impacts on small entities under the RFA. E.O. 12866 defines a "significant regulatory action" as likely to result in (1) an annual effect on the economy of $100 million or more; (2) an adverse effect in a material way on the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local or tribal governments or communities; or (3) a novel legal or policy issue. Requirements of the RFA are addressed in Section 4.

When a fishery management problem is identified, and management action considered, either in the form of a formal amendment to a Fishery Management Plan or through a Regulatory Amendment, the Magnuson Fishery Conservation and Management Act (MFCMA) and Executive Order 12866 (EO 12866) require that the **"net benefit to the Nation"** be assessed for a range of feasible alternative actions. All benefits and costs, attributable to any feasible alternative action, including retention of the "status quo", must be identified and, to the extent practicable, quantified.

The only limitation is that only benefits and costs which accrue to U.S. entities, e.g., U.S. consumers, taxpayers, businesses, communities, etc., need be included in the "net benefit" calculation. That is, any benefit conferred, or cost imposed, by a proposed action which accrues to a "foreign", i.e., non-U.S., entity is not appropriately included, and need not be accounted for, in the "net benefit" analysis. This has particularly significant implications for the regulatory impact review of the proposed amendment to control bycatch of "other" salmon in the BSAI pollock 'B' season, as the following sections will indicate.

3.0.1 "Other" Salmon Bycatch

Because of their economic (and cultural) importance to U.S. commercial, subsistence, and recreational fisheries which target these species, Pacific halibut, king and Tanner crab, herring, and Pacific salmon have been designated as "prohibited", under the MFCMA for all groundfish operations. Formal bycatch limits have been established for Pacific halibut, king and Tanner crab, and herring in the Bering Sea groundfish fisheries, but no limits had been established for salmon until the April 1994 Council action to provide a cap for "other" salmon in 1994 by ER. Despite the designation of "prohibited", the bycatch of prohibited species continues in groundfish fisheries and is of concern to the Council, NMFS and ADF&G, among many agencies.

Trawl fisheries, such as those conducted in the Bering Sea and Aleutian Islands management area, utilize an essentially nonselective harvesting technology, sweeping up virtually everything in their path. Because of the sheer volume of the directed catch in these fisheries, they can incur substantial bycatches towards their Prohibited Species Catch (PSC) caps, even when rates of bycatch per unit of directed catch are relatively low. In other cases, large prohibited species bycatches may occur sporadically, relatively suddenly, or in limited areas. For example, an unusually large number of "other" salmon,[1] comprised mostly of chums, were caught incidentally by mid-water trawl catcher vessels operating in the Catcher Vessel Operational Area (CVOA), during the 1993 pollock 'B' season. Estimates place the chum bycatch at approximately 232,750 fish (out of an estimated 245,000 "other" salmon bycatch for the entire year) Bering Sea-wide, with approximately 80% occurring in the CVOA. Chum salmon bycatches of this magnitude may cause conservation and management problems.

Concerns about chum salmon bycatch were exacerbated in 1993 by the poor returns to Western Alaska river systems in that year. The Alaska Department of Fish and Game (ADF&G) closed commercial, subsistence, and recreational fisheries in several Western Alaska districts in 1993 because returns were poor. Projections for 1994 Western Alaska chum runs were, in general, for below average returns in many districts. However, Western Alaska returns in 1994 were average to above average and much better than those experienced in 1993.

The "other" salmon intercepted in the 1993 pollock 'B' season were primarily in the size range of 3 year-old fish that would have matured in 1994 (see above, 1.3.4). Data on 1994 Western Alaska chum salmon returns, and pollock 'B' season "other" salmon bycatches are preliminary. When compiled, a much clearer indication of the scope and significance of this potential "other" salmon bycatch problem will be evident. Unfortunately, the Council and Secretary do not have the luxury of waiting for these data. The economic and social risks of inaction, should PSC bycatches of this magnitude be repeated in successive seasons, is deemed to be far greater than potential costs associated with development of conservation strategies that would permit NMFS (on behalf of the Secretary) to respond immediately to excessive PSC interceptions in these fisheries and/or areas.

It is possible that the 1993 pollock 'B' season chum bycatch was an anomaly, resulting from a combination of oceanographic conditions, "other" salmon year class abundance, and/or changes in trawl fishing patterns. Certainly, recent "other" salmon bycatches from the time period corresponding to the current pollock 'B' season have not approached levels seen in 1993. As indicated above, this may be because trawl effort was not present at the same locations and focused during the same time in previous years. Between 1987 and 1989, "other" salmon bycatches in the Bering Sea were

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[1] "Other" salmon is defined as salmon other than chinook salmon. Historical data indicate that approximately 95 percent of the "other" salmon bycatch in the Bering Sea is chum salmon.

reportedly less than 10,000 fish. In 1990, 1991, and 1992, the numbers rose to 16,196, 36,000, and 39,000 fish, respectively (source: NMFS observer data) with effort distributed along the entire shelf break and from mid-summer through the fall.

Nonetheless, if no regulatory means of controlling excessive future bycatch interceptions is in place, a large number of "other" salmon could, once again, be incidentally caught during the pollock 'B' season in future years because of the coincidence of time and area management actions which are currently in place. Therefore, the Council has proposed an amendment to the FMP for Groundfish Fisheries in the Bering Sea and Aleutian Islands, that would impose time and area closures for groundfish trawl vessels. Under Alternative 2, a specified area (dependent upon the option selected) would be closed to all trawling, for the entire year. Under Alternative 3, a specific area (depending on the option selected) would be closed during a time of high bycatch (the month of August), and once a specified number of "other" salmon are bycaught in the pollock 'B' season fishery, the specific area would be closed to all trawling until October 15. Either alternative to the status quo would be expected to provide significant "other" salmon bycatch savings. The principal questions are, at what cost will these savings be achieved, and to whom will benefits and costs from "other" salmon savings accrue? It is the "tradeoff" between potential benefits from bycatch reductions, and potential costs to the U.S. groundfish fishing industry from foregone catch, dislocation, and/or idleness, that distinguishes the two alternatives to the status quo, and the seven area closure options and two sub-options, from one another.

3.0.2 "Source of Origin" Information

An answer to the question of, "who gains from 'other' salmon bycatch savings", is complicated. This is so, in part, because there is no definitive scientific evidence indicating the source of origin of the bycaught chums intercepted in the pollock 'B' season, as discussed above in Section 1.3.4. Based upon the available "source of origin" studies for the North Pacific and Bering Sea, it is apparent that chum salmon from a variety of sources are co-mingled throughout the area.

The 1993 Western Alaska chum salmon run failure is a significant, but certainly not the exclusive, motivation in the Council's decision to address the potential PSC bycatch problem associated with the pollock 'B' season in the Bering Sea. Although a below average return was expected, the cause of the failure of runs in 1993 remains largely a mystery. The Yukon River Technical Committee notes that, "Chum salmon run failures were evident in 1993 across a broad region of Alaska, including the Yukon River in Alaska and Canada. While the cause for the production failures are not known, some attention has focused on the marine environment because of the broad scope of the production failures. There has been speculation as to whether marine competition among chum salmon may be a factor, especially considering the magnitude of the chum salmon fry releases from Japanese hatchery program..." The Committee goes on to report that, "(Japanese hatchery) chum salmon fry releases increased steadily until 1980, at which point they stabilized at approximately 2 billion per year."

In the June 1994 edition of *Pacific Fishing*, it is reported that, "Five new (chum) hatcheries have been built (on the Kamchatka peninsula) with the help of Japanese financing and expertise," (p.26). An estimated 20,000 tons of mostly chum salmon were reportedly imported from these Russian facilities into Japanese markets in 1993. This suggests that Asian chums, particularly from hatcheries, continue to increase. Although the impacts on the North Pacific or Bering Sea are difficult to quantify, the increases further suggest that the relative abundance of Asian-source chums, as compared to, especially, Western Alaska-source chums, is likely to continue to increase.

While prohibited species bycatches are not assumed to be the principal cause of the Western Alaska chum salmon run failures, any significant additional loss to already depressed stocks is undesirable.

More precisely, in the face of potentially severely depressed North American chum salmon runs, any bycatch mortality of chums destined for U.S. rivers and streams, imposes real costs on all potential U.S. users of the resource, e.g., subsistence fishermen, commercial harvesters, processors, retailers, and domestic consumers. Therefore, any reduction in bycatch losses of U.S. chum salmon represent a potential "benefit to the Nation."

3.1 Estimating Benefits from Reduced Bycatch Losses

As the previous discussion indicates, existing information on the source of origin of the chum salmon intercepted in the Bering Sea groundfish trawl fisheries, and in particular the CVOA pollock 'B' season, cannot be employed to derive estimates as to how many of the approximately 245,000 "other" salmon intercepted in these fisheries, are of U.S. origin. Therefore, a quantitative estimate of the potential economic benefit to the Nation, accruing from a specific reduction in groundfish trawl bycatch interceptions of chum salmon in the CVOA, cannot be made.

The quantification of the mixture of stocks of various origins is currently impossible. As discussed above (Section 1.3.4), although North American chum salmon have a more restricted distribution than Asian chum, remaining closer to North America, and immature chum salmon also appear to have a more restricted range than do maturing fish, there is a high degree of mixing of stocks in the North Pacific and Bering Sea. Canadian and Asian (and particularly Japanese and Russian hatchery) stocks are both present and increasing in abundance throughout the North Pacific and Bering Sea. Indeed, some Canadian fisheries interests have asserted, in connection with the "transboundry salmon dispute" between Alaska, British Columbia, and the U.S. Pacific Northwest, that many of the bycaught salmon in the U.S. groundfish fisheries are of Canadian origin. While no evidence substantiating (nor, for that matter, refuting) this assertion has been offered, it does reveal the contentiousness, and potential cost, that uncertainty surrounding salmon bycatch composition can engender.

What is indisputably clear is the following: 1) that reductions in bycatch mortality of U.S. chums in the mid-water trawl pollock 'B' season will confer benefits to the Nation, 2) that reductions in mortality to U.S. chums from systems like those of Western Alaska, which are thought to have severely depressed runs, will confer the greatest benefit to the Nation per fish saved, and 3) that reduction of total bycatch of "other" salmon, in the pollock 'B' season will, almost certainly, reduce the mortality of chums from U.S. sources, including those from distressed Western Alaska stocks.

Without definitive scientific data as to the proportion of the pollock 'B' season bycatch composed of U.S.-origin fish, and the specific source of origin among the salmon of U.S.-origin, e.g, how many from A-Y-K, how many from S.E. Alaska, how many from South Central Alaska, how many from Washington, etc., a more quantitative treatment of the economic benefits of "other" salmon bycatch savings in these fisheries is not possible.

3.2 Costs Attributable to the Proposed Action

Any regulatory action which has the effect of limiting the timing and/or location of fishing activity can be assumed to impose costs. In the case of the proposed amendment, each alternative to the "status quo" under consideration would close predetermined areas of the CVOA (and, under some options, adjacent waters) to all trawling, either, in the case of Alternative 2, for the entire year, or under Alternative 3, after July 1 or upon the industry's attainment of a maximum "other" salmon bycatch limit, to October 15. This would presumably force some operators to move their fishing activities to alternative areas, either within the CVOA (in those options where such areas remained open) or outside that zone.

While it is impossible to predict with certainty how a specific time/area closure would affect the domestic industry, as a whole, it is apparent that, 1) operating costs will likely increase for those operations forced to relocate; 2) CPUE may decline as a result of the relocation; 3) crowding externalities may impose some costs as the same number of vessels may now be forced to compete for catches in a smaller total area; and 4) smaller vessels [and those delivering to processors adjacent to the CVOA] will have fewer alternatives [and may face greater competition for remaining "open" areas of the CVOA] than more mobile operations, i.e., mothership-based operations.

More specifically, a closure which displaces an operation (including those operations participating in a CDQ Program) from an area in which it has chosen to operate has the potential to impose costs. Presumably, an operator fishing in, say, area "A" is doing so because that area is "preferred", in some sense, over alternative areas. It may be that an operator has more experience with fishing conditions in area "A"; has expectations of higher catches there than in alternative areas; the area requires less time and expense to reach; or is less congested than alternative areas. If one observes a profit maximizing operation fishing in a given area, one must presume the area represents the best perceived option available.

Thus, if a closure forces that operator to leave that "preferred" location, that action imposes potential costs. It may do so in several ways, as delineated below. For example, it may well increase operating costs, since time and resources, e.g., fuel, are required to move the operation to an alternative (presumably inferior)[2] fishing location. The proposed action may[3] also impose costs on displaced operations, in the form of reductions in total production, since time spent in transit from the "preferred" area to the alternative area is time not directly involved in harvesting (or processing) fish.

Costs, in the form of crowding externalities, may be imposed if, 1) sufficiently large areas of the CVOA are closed to all trawling, and 2) a sufficiently large proportion of the displaced capacity (effort) relocates to the remaining "open" areas of the CVOA. If, however, adequately large, and presumably productive, areas of the CVOA remain available, and/or sufficient effort relocates to open areas outside the CVOA following a bycatch-triggered closure, these costs will not be imposed.

It is impossible to predict in advance whether any such costs will be incurred by the domestic trawl industry, and if incurred how great the costs might be. Because of the relative lack of operational mobility of smaller vessels (and those delivering to shore-side plants), the larger the size of a CVOA closure, and the nearer the closure area to the Aleutian chain, the greater will be the potential cost to this segment of the industry. That is, for example, a bycatch-triggered closure of the entire CVOA might impose a virtual "shut-down" order on the small and shore-side based segment of the industry, while mothership operators with the capacity to move outside the CVOA might incur relatively limited costs, or indeed, might incur benefits if it happens that this component of the fleet is more efficient.

Alternatively, if areas of the CVOA which are, for all practical purposes, outside or near the effective margins of small and/or shore-side vessels' operating range were closed as a result of "other" salmon

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[2] It must be presumed to be "inferior" (or at the very least, no better) since if it were more profitable the operator would have been operating there voluntarily. This of course assumes that the operator has perfect knowledge of all alternative fishing outcomes.

[3] It "may" reduce total production. However, it is possible that CPUE and total catch could actually be better in the alternative area, if the operator was mistaken about the relative productivity of the two areas. Once on-site in the new location, if CPUE was sufficiently high, catches could compensate for the lost fishing time, used in transit, and total catch could actually increase.

bycatch, most of the costs imposed would accrue to the operators which would be displaced, i.e., motherships and their catcher-boats, while the inshore sector might experience little or no direct adverse impacts. The latter group could, however, experience indirect costs, as cited above, if a significantly large amount of the displaced capacity stayed in the remaining open sections of the CVOA and competed with the small and/or inshore vessels.

In addition to the potential costs of the proposed action on harvesters operating in the CVOA, increases in costs, reductions in revenues, or both, may accrue to other elements of the pollock supply network. For example, if the bycatch-triggered CVOA closures result in increased operating costs for domestic pollock producers, these costs may, in full or in part, be passed along through wholesalers and retailers, to the consumers of the final product. Higher consumer prices will, all else equal, reduce consumer surplus.

This "cost", in the form of less product and diminished consumer surplus, would be deducted from any benefits accruing from the management action, to the extent that the affected individuals were U.S. consumers. However, because most of the product from these pollock fisheries is exported, cost increases would, presumably, be passed through to foreign consumer (pers. comm., Richard Kinoshita, 1994). These consumer surplus losses do not constitute a "cost to the Nation", within the meaning of the MFCMA "net benefit" context, and would not be deducted from any benefits accruing from the Council's action.

3.2.1 Other Direct Costs of the Alternatives to the Status Quo

If alternative 3 implemented a time/area closure when a specified other salmon bycatch limit was reached, additional observer coverage may be required for motherships that receive groundfish caught in the CVOA during the pollock 'B' season to provide accurate accounting of "other" salmon bycatch. This additional coverage would only be necessary until the cap had been attained. Alternative 3 would also include requirements for the affected motherships, and for shoreside processors that are subject to 100 percent observer coverage and that receive groundfish harvested in the CVOA during the pollock 'B' season, to have the necessary hardware and software available for the observers to transmit salmon bycatch data electronically. The necessary hardware and software were installed and utilized on most affected operations in order to monitor chum bycatch for the 1994 pollock "B" season ER.

Direct costs for observer coverage are estimated to be about $200 per day per observer. The cost of a second observer on each mothership operating in the CVOA during the pollock 'B' season would depend on the number of days the additional observer was required. The number of observer days for each mothership during the 1993 'B' season ranged from 39 to 58 days. Based on the observer coverage requirements for 1993, a second observer during future 'B' seasons could cost from $7,800 (39 days x $200/day) to $11,600 (58 days x $200/day) per mothership for the entire season. Based on the actual number of fishing days reported for the four motherships operating in the CVOA in 1993, the total cost for all four motherships, if the second observer was required for the entire period, would have been $37,400 (187 days x $200/day). This cost range would be a maximum given a prohibited species cap and high bycatch, since the observer would only be required until the cap had been attained. During 1994, the closure occurred after the first week of the season and associated observer costs would have been much lower. Obviously, in future years the number of motherships operating in the CVOA pollock 'B' season may be greater or smaller, thus affecting the estimated total cost. Likewise, if the second observer is required for only a portion of the 'B' season, additional observer costs would be reduced, e.g., $200 per day per mothership processor times the actual days with a second observer.

Observer costs for 1995 would be incurred by the vessel and would not come under the authority of the Research Plan. For 1996 and beyond the placement of observers on vessels will be annually specified under the Research Plan.

Under the ER, most hardware and software costs have previously been incurred by vessels and plants processing in 1994. Costs could be incurred for the acquisition of 'e'mail software and a personal computer that satisfies the hardware requirements detailed under Alternative 3. The cost for these items could range from $200-$1200. It should be noted, however, that the motherships have the INMARSAT satellite communication capabilities and most shoreside facilities have the necessary computer hardware for electronic transmission of data. NMFS would supply the necessary data entry software and may provide installation free of charge to vessels which do not already have the necessary software, so these costs should not be a significant burden.

3.3 Area Closure Options

Each of the optional closure areas under consideration is associated with unique combinations of costs and benefits. That is, each option presents a "trade off" between potential reductions in "other" (primarily chum) salmon bycatches in the groundfish trawl fisheries, and potential reductions in total directed catches of, primarily, pollock in the CVOA during the 'B' season. These "tradeoffs" are described, for each closure option, and a "net" benefit assessment presented. Seven options, and two sub-options, for area closures identified under both Alternative 2 and Alternative 3 are described below:

Option 1: "The Contour". A 15 mile buffer extending to either side of the 200 m depth contour which extends to the north and west from the "horseshoe" and Unimak Island (Figure 1). This contour buffer was found to correspond to high chinook salmon bycatch, as presented in Amendment 21b to the BSAI Groundfish FMP.

The proposed closure, under Option 1, does not appear to be an efficient means of controlling "other" salmon bycatch. Only a small proportion of the "other" salmon bycaught within the contour were captured north of 56° N latitude, or west of 168° W longitude. Yet, these same areas represent highly productive fishing grounds for the domestic groundfish trawling industry. Thus, a closure of the northern portion of the contour buffer could potentially result in a relatively high cost to the domestic groundfish fishing industry (in the form of foregone directed catch and higher operating expenses), with low savings in "other" salmon bycatch. For example, in the period from July through October, approximately 26% of the total 1993 groundfish catch came from the contour buffer. Roughly 32% of the total 1993 "other" salmon bycatch came from the contour buffer during this same period. However, almost all of that bycatch came from the southern portion of the contour, an area contained in large part within the CVOA. In fact, the portion of the contour buffer which lies outside the CVOA has only accounted for between 3% and 13% of the total bycatch of "other" salmon during the months of July through October (Table 11). This suggests that a "less restrictive" closure could yield essentially equivalent bycatch savings, while substantially reducing the potential adverse impact on groundfish harvests. From the perspective of the "net benefit to the Nation", adoption of this option would not yield the highest net benefit among all options under consideration. Indeed, expected benefits from "other" salmon bycatch savings, under this option, may not be sufficient to offset the sizable costs of foregone groundfish catches that could be anticipated by the proposed closure, yielding a possible negative "net benefit to the Nation" from adoption of this option, under either Alternative 2 or Alternative 3. Whereas this option might be effective for chinook salmon bycatch management, there would be few benefits derived for chum salmon bycatch management under this option.

Option 1b: "The Contour within the CVOA". Closure of a 15 mi buffer on either side of the 200 m contour within the CVOA.

As indicated above, the portion of the contour buffer which lies outside the CVOA has only accounted for between 3% and 13% of the total bycatch of "other" salmon during the months of July through October (the period associated with the majority of "other" salmon interceptions). The portion which lies within the CVOA, on the other hand, has consistently accounted for between 25% and 42% of the total "other" salmon bycatch during this period (Table 11).

The percentage of the groundfish catch taken in this area during July through October is similarly high, accounting for between 17% and 36% of the total harvest. Furthermore, due to the proximity to "onshore" processing facilities, this area of the CVOA is disproportionately important to the smaller catcher vessels, and those which deliver their catch ashore.

Because of the "onshore" segment's relative lack of mobility, as compared to catcher vessels supporting mothership operations, any action that closes substantial (and highly productive) fishing areas nearest the Aleutian chain in the CVOA may impose severe economic and operational hardship on this subset of the domestic groundfish fleet. These costs may be justified, if, for example, equivalent or greater savings in "other" salmon bycatches could not be obtained by adopting another area closure option. This does not, however, appear to be the case. Therefore, the disproportionate burden which would be imposed on small and/or "shore-side processor" dependent catcher vessels, should this option be selected, does not yield the greatest "net benefit to the Nation" among the range of options under consideration, under either Alternative 2 or Alternative 3.

Option 2: "The Contour plus Unimak". The area defined under (1) above in addition to two blocks to the north of Unimak Island and the "horseshoe" (Figure 1). The combination of these blocks with the contour buffer accounted for a high percentage of chinook bycatch in Amendment 21b.

The area defined under this option accounts for a greater percentage of "other" salmon bycatch than does the area defined in Option 1. However, as with Option 1, the northern portion of the contour buffer, while providing savings for chinook salmon during winter months, does not appear to be an important area for "other" salmon during the summer/fall months. The cost, in terms of foregone groundfish harvests along the contour outside the CVOA, could be expected to far exceed any benefits in "other" salmon savings from adoption of this closure option. Furthermore, as suggested under Option 1b, the cost of the closure of the two blocks to the north of Unimak Island and the "horseshoe" falls disproportionately upon the segment of the domestic fleet which is least mobile, and thus least able to compensate for the regulatory change. If the potential savings from adoption of this option were sufficiently greater than any other option under consideration, the costs of reduced groundfish harvests outside the CVOA along the contour and those imposed on the small and/or "shore-side processor" dependent vessels might be justified, in terms of the "net benefit to the Nation". This is, however, not the case. Therefore, adoption of this closure option would not yield the greatest "net benefit to the Nation" among the range of options under consideration, under either Alternative 2 or Alternative 3.

Option 2b: "The Contour within the CVOA plus Unimak". The portion of Option 2 falling within the CVOA as described in Option 3.

Inclusion of the two blocks north of Unimak Island with the contour buffer within the CVOA as in Sub-option 1b dramatically increases the percentage of "other" salmon bycaught within the area over the percentage of "other" salmon bycaught in the contour alone (and thus the potential savings). It also removes portions of the contour buffer, outside the CVOA, which are productive groundfish

fishing areas, but which contribute relatively little "other" salmon bycatch savings, during the period of concern. In this way, this option reduces the potential costs, in terms of foregone groundfish harvests, while retaining the potential bycatch savings, cited in option 2.

Individually, the two Unimak blocks accounted for between 23% and 37% of the "other" salmon bycatch during July through October (Table 11), and only 1% to 7% of the total groundfish catch during the same period. The combined area of the contour buffer within the CVOA and the Unimak Island blocks accounted for between 47% and 77% of the "other" salmon bycaught between July and October, and between 18% and 43% of the total groundfish catch during the same period. As these data suggest, this closure option yields very substantial potential "other" salmon bycatch savings. It does so, however, at the cost of relatively significant potential reductions in the total CVOA groundfish harvest options, depending upon the fishing year examined, and the Alternative selected. It also tends to disproportionately impact the smaller and/or "shore-side processor" dependent segment of the domestic fishing fleet.

As in the case of option 1b, the cost of this closure falls disproportionately upon the segment of the domestic fleet which is least mobile, and thus least able to compensate for the regulatory change. If the potential savings from adoption of this option were sufficiently greater than any other option under consideration, the costs of reduced groundfish harvests destined primarily for inshore processors and the costs imposed on the less mobile, small and/or "shore-side processor" dependent vessels might be justified, in terms of the "net benefit to the Nation". This is, however, not the case. Therefore, adoption of this closure option would not yield the greatest "net benefit to the Nation" among the range of options under consideration, under either Alternative 2 or Alternative 3.

Option 3: "The CVOA". The catcher-vessel operational area (CVOA) as currently described for management of inshore and offshore fisheries apportionment during the BSAI pollock 'B' season (Figure 2).

Although this area has consistently accounted for approximately 80% of the "other" salmon bycatch during the last four years, the CVOA has also become increasingly important to groundfish fishermen. The CVOA accounted for between 19% and 33% of the total groundfish catch for the BSAI during the months of July through October in 1990, 1991, and 1992, and accounted for 53% of the groundfish catch in 1993 (summing areas which make up the CVOA in Table 11). It is possible this increased effort in the CVOA has helped increase "other" salmon bycatch levels. It is noteworthy that, in 1993, the "other" salmon bycatch in the portion of the CVOA which was not in the Unimak Island blocks or the contour buffer accounted for an unexpectedly high portion of the "other" salmon bycatch, i.e., 33%, for a disproportionately small 9% portion of the groundfish catch (see Figures 41 and 42). With the regulations restricting access to the CVOA by processor-type and designation, this area has become more important to the "inshore" harvesting sector of the domestic fleet.

Indeed, the CVOA was established under Amendment 18 to the Groundfish FMP for the Bering Sea and Aleutian Islands ostensibly to "level the playing field" between the larger, highly mobile catcher/processor segment of the industry and the smaller, less mobile catcher vessels, especially those delivering to shoreside plants. Closure of the CVOA, either for the entire fishing year as under Alternative 2, or for the balance of the fishing year following attainment of a bycatch cap for "other" salmon, as under Alternative 3, would be expected to result in "other" salmon bycatch savings. To the extent that those "other" salmon were of U.S.-origin, benefits would accrue to the Nation. But, as cited above, any such benefits would be obtained at a very significant cost. These costs would be expected to include, among others, very substantial foregone groundfish harvests, displacement of significant portions of the groundfish fleet, and effective idling (closure) of small and/or "shore-side processor" dependent vessels, and the onshore plants they supply.

Assume for the moment that the Council selected Alternative 2, in combination with Option 3. Under this regulatory regime, the entire CVOA would be closed to all trawling from January 1 through December 31, each year. Had such a closure been in place in 1993 (the latest year for which complete data are available), for example, 3 motherships, and 13 catcher/processors acting as motherships, with total groundfish catches of approximately 35,307 mt, and 102 catcher vessels delivering inshore, with total groundfish catches of approximately 386,775 mt, would have been displaced. The estimated value of these catches, at an exvessel equivalent, employing 1993 weighted average exvessel prices as reported on ADF&G fishtickets still needs to be compiled to complete this section[4]. While some of the foregone groundfish harvest would certainly have been made up from areas outside of the CVOA by the more mobile segments of the fleet, for that segment of the fleet which is either too small and/or dependent on delivering catch to onshore processors, located adjacent to the CVOA, alternative fishing opportunities would have been very limited. It seems likely that a substantial portion of this segment of the domestic groundfish industry would have been effectively "closed down" by adoption of this regulatory scheme. In addition, the inshore and onshore processing facilities dependent upon the delivery of groundfish from the CVOA would have been without a source of supply of raw fish, and thus idled, for purposes of groundfish processing at least, by adoption of Alternative 2 in combination with Option 3.

Under Alternative 3, Option 3, a closure of the entire CVOA would occur only after July 1, or after the total number of "other" salmon intercepted in the trawl fisheries of the BSAI exceeded a prescribed fish cap. A cap of 42,000 other salmon was selected for the ER in 1994 and that number is included here for discussion purposes; although the Council has the option to choose another cap under alternative 3. In an average year given a cap, based on historical data, no closure would occur, as bycatches of "other" salmon have always been below the 42,000 threshold. In a year of exceptionally high bycatch, as in 1993, the 42,000 "other" salmon catch would impose an area closure. Using 1993 catch data as an example, the 42,000 fish cap was exceeded roughly at the end of the first week of the pollock 'B' season. Had this regulatory regime been in place, the entire CVOA would have been closed, at that point, to all further trawling for the balance of the year. Had such a closure occurred, 11 catcher/processors operating as motherships with total groundfish catches of approximately 21,460 mt, as well as 70 catcher vessels delivering inshore, with total groundfish catches of approximately 175,807 mt would have been displaced. The estimated value of these foregone catches at exvessel, employing 1993 weighted average exvessel prices as reported on ADF&G fishtickets still needs to be compiled to complete this section[4].

While some of the foregone groundfish harvest would certainly have been made up from areas outside of the CVOA by the more mobile segments of the fleet, for that segment of the fleet which is either too small and/or dependent on delivering catch to onshore processors, located adjacent to the CVOA, alternative fishing opportunities would have been very limited. It seems likely that a substantial portion of this segment of the domestic groundfish industry would have been effectively "closed down" for the balance of the fishing year by adoption of this regulatory scheme. In addition, the inshore and onshore processing facilities dependent upon the delivery of groundfish from the CVOA would have seen their supplies cut off following attainment of the "other" salmon cap. This would have likely idled these operations, at least for purposes of groundfish processing, for the remainder of the fishing year.

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[4] Motherships are not required to complete ADF&G fish tickets while operating in the EEZ. While some do so voluntarily, the "price" field is not consistently completed, and cannot be verified. Therefore, for purposes of this estimate, the weighted average exvessel price, as reported for inshore deliveries in 1993, will be applied to all groundfish sales from the area in question.

Therefore, in any fishing year when "other" salmon bycatches exceeded the 42,000 fish limit, adoption of Alternative 3, in combination with Option 3, could impose relatively substantial costs, in the form of foregone catches, on some sectors of the domestic groundfish industry. Further, these costs would be disproportionately born by the smaller, less mobile, and/or "shore-side processor" dependent vessels and the onshore plants, themselves. The magnitude of these costs would be dependent upon the specific timing of the closure and the total directed catch obtained before that date. The more rapid the attainment of the cap, the greater the potential cost to the industry, under this management scenario.

On the basis of the foregoing analysis it is apparent, even in a relative sense, that adoption of Option 3, "the CVOA closure option", would not yield the greatest "net benefit to the Nation", among the range of options being considered, under either Alternative 2 or Alternative 3.

Option 4: "Area 517". NMFS management area 517 (Figure 3).

Area 517 comprises the northwest portion of the CVOA and extends to the north and west to near the Pribilof Islands. This area has accounted for between roughly 27% and 87% of the total annual "other" salmon bycatch taken during the months of July through October. Due to the high degree of overlap between Area 517 and the CVOA, the percentage of groundfish catch and "other" salmon bycatch which were taken from Area 517 within the CVOA was estimated. Examining the groundfish catch taken during the months of July through October, 98%, 83%, 96%, and 78% of the catch in Area 517 was taken within the CVOA in 1990, 1991, 1992, and 1993, respectively. Similarly 100%, 97%, 99%, and 81% of the "other" salmon bycatch from Area 517 was taken within the CVOA in 1990, 1991, 1992, and 1993, respectively. Thus the portion of Area 517 which lies outside of the CVOA is only marginally important for groundfish catch, and, with the exception of 1993, insignificant for "other" salmon bycatch.

Closure of management area 517 to all trawling, either for the entire year, as under Alternative 2, or for the balance of the fishing year following, for instance, attainment of an "other" salmon bycatch cap, as under Alternative 3, would impose a similar range of impacts as those outlined under Option 3. It would, in addition, 1) potentially increase the aggregate amount of groundfish harvest foregone, by extending the closure to a greater total geographic area of the Bering Sea, although, in fact, a small portion of the CVOA (3 blocks) would be unaffected by such a closure, and 2) potentially increase the dislocation of (and associated cost to) the relatively more mobile segments of the fleet, by requiring affected operators to travel farther to find "open" fishing areas. In combination, these would reduce the net earnings of this segment of the fleet.

As before, for those operators (catcher vessels and onshore plants) with a limited capacity to respond to the proposed closure by relocating to the remaining open BSAI management areas and three CVOA blocks, this option would impose a significant closure of their operations, either for the entire year (Alternative 2), a portion of the year, or following attainment of a cap (Alternative 3).

In either case, the increase in potential benefits of this option, as measured in additional U.S.-origin "other" salmon bycatch savings, would not be expected to offset the anticipated costs, delineated above. It is apparent from the foregoing that adoption of this closure option would not yield the greatest "net benefit to the Nation" among the range of options under consideration, under either Alternative 2 or Alternative 3.

Option 5: "9 blocks". The nine blocks which form the top portion of the CVOA extending to the west from Unimak Island, and including a block above the northwest corner of the CVOA (Figure 4).

These nine blocks do not include the "horseshoe" area, which is significant for both groundfish catches and salmon bycatch. As discussed above, the increase in effort in the portion of the CVOA outside of the contour buffer or the Unimak blocks in 1993 (9% of groundfish catch) led to a disproportionate increase in the percentage of "other" salmon bycaught in that area, (i.e., an increase to 33% of the "other" salmon bycatch). Groundfish catch during July through October, within the nine blocks, accounted for between 1% and 2% of the total annual groundfish catch between 1990 and 1992. That percentage increased to 10% of the total annual groundfish catch in 1993. Of the groundfish catch taken only during July through October, the nine blocks comprised between 1% and 5% of the total groundfish catch between 1990 and 1992, but grew to 21% of the total groundfish catch during that period in 1993.

Between 39% and 44% of the total annual "other" salmon bycatch was taken from these nine blocks between July and October of 1990 through 1992. This figure grew to 67% of the total annual "other" salmon bycatch in 1993.

It should be noted that some of the nine blocks, particularly to the north and west, have historically received very little fishing effort. Because these blocks abutted squares with relatively "high" salmon bycatch, they were included in this closure option, under the assumption that given increased effort, these blocks would also have high bycatch. This will remain only an hypothesis until such time as sufficient fishing effort is applied to these blocks and catch and bycatch data can be empirically analyzed.

NMFS annual groundfish trawl surveys suggest that pollock are present throughout the nine block area in relatively significant concentrations. When selecting for fish of commercial size, i.e., > 34 cm. in length, the NMFS survey data show commercial concentrations within the nine block area in each of the years, 1989 through 1993, examined (see survey diagram, Figures 44 - 55). These same data confirm that significant concentrations of commercial-size pollock also are present outside of the "9 block" closure area, both within the CVOA and outside its boundaries. Because this closure option includes a relatively large portion of the total CVOA, its closure, either for the entire year as under Alternative 2, or until October 15 as under Alternative 3, would substantially diminish the area within the CVOA available to the industry. For operations with the capability to move outside the CVOA, this may not create a serious problem. As the survey data suggest, commercial concentrations of pollock are widely distributed across the eastern Bering Sea, just prior to the 'B' season opening. For smaller, less mobile vessels, and those dependent upon onshore processing capacity, an area closure of this size could impose significant costs. These may take the form of, among others, reductions in available fishing areas, and crowding externalities, should significant amounts of displaced effort choose to relocate to the remaining open areas of the CVOA. It is, of course, not possible to predict the likelihood or magnitude of such adverse impacts, a priori. But it is important to be aware that such impacts could occur.

While pollock stock concentrations are highly variable over time and geographic location, the surveys, which are undertaken in the early summer each year, also suggest that these nine blocks consistently contain large concentrations of pollock in the CVOA during the 'B' season. The survey does not extend into the "horseshoe", so that segment of the population in any year is not represented in Figures 44 - 55. However, closure of these nine blocks, either under Alternative 2 or Alternative 3, would be expected to result in substantial reductions of total pollock catches from the CVOA. As the survey diagrams indicate, in each year between 1989 and 1993, large concentrations of "marketable sized" pollock in the CVOA were found within the "nine block" closure area which comprises approximately 1/2 the total area of the CVOA. While concentrations of commercial-size pollock were found outside the nine blocks, making up the foregone catch of pollock from a closure of the area defined under this option might not be possible by shifting to the remaining areas of the

CVOA. It may be possible for the more highly mobile elements of the fleet to make up some or all of their foregone catches outside of the CVOA. This option would not be possible for the less mobile and/or "shore-side processor" dependent segments of the domestic catcher fleet.

By using 1993 catch data, by block, and 1993 exvessel values, under Alternative 2 (closure of these 9 blocks for the entire year), the foregone groundfish harvest would have a value which has yet to be compiled but will be provided in future versions of this document. Under Alternative 3, this option could result in foregone catches with a value to be similarly compiled. This is an upper-bound estimate, since almost certainly, some portion of the projected foregone catch would be made up from areas outside the CVOA and/or from blocks within the CVOA not effected by this closure option. It is not possible, a priori, to predict these amounts with precision. It is, however, appropriate to acknowledge that such impacts may occur.

As with the other closure options examined above, the 9 block option is an attempt to balance gains, in the form of bycatch savings, with losses in directed catch, without disproportionately burdening the smaller or less mobile segments of the domestic industry. In this regard, the nine block option would appear to be superior to the other options examined thus far. It provides for significant potential savings in "other" salmon bycatch (ranging from 39% to 67% of the total annual interception over the period 1990 through 1993). It reduces the total area of the closure (potential, under Alternative 3) when compared to options 1, 2, 3, and 4, although it may close a somewhat larger total area than options 1b and 2b. It reduces the potential disproportionate burden placed on the smaller and/or "shore-side processor" dependent segment of the fleet, by focusing the closures in blocks which are relatively more distant from the "horseshoe" and near-shore fishing areas along the chain. And it has a relatively smaller potential adverse effect (and therefore reduced economic impact) on total groundfish catch, than do the other options evaluated thus far. Of the first five closure options evaluated, the 9 block option appears to impose the smallest potential cost, although these costs remain substantial, with the largest potential benefit, as measured in "other" salmon bycatch savings.

An examination of Options 6 and 7 will, however, suggest that adoption of Option 5 (the "9 block" closure option) would not yield the greatest "net benefit to the Nation" among the range of options under consideration, under either Alternative 2 or Alternative 3.

Option 6: "7 blocks". The seven blocks identical to those described in Option 5, with the two above Unimak Island eliminated (Figure 5).

Closing seven of the nine blocks contained under Option 5, but retaining access to the two eastern-most blocks, this option accounted for similar groundfish catch levels as reported under Option 5 above. "Other" salmon bycatch levels were also similar during 1993 (59% of total annual "other" salmon bycatch taken between July and October). However, "other" salmon bycatch occurred more in the eastern portion of the CVOA in 1990, 1991, and 1992, and blocks under this alternative only accounted for 14%, 16%, and 24% of the total annual "other" salmon bycatch, respectively, during those years. It appears that the more easterly of the Unimak blocks, and the block immediately above it, more consistently account for "other" salmon bycatch than do the blocks more to the west.

Thus, this option would, on average, produce lower "other" salmon bycatch savings, but approximately equivalent effects on total pollock catches, as those attributable to the nine block closure. On the basis of this simple comparison, i.e., bycatch savings per unit of pollock catch foregone, Option 6 appears to be somewhat inferior to Option 5. As with the other closure options examined above, however, the 7 block option represents an attempt to balance gains in bycatch savings with losses in directed catch, without disproportionately burdening the smaller or less mobile segments of the domestic industry. In this latter regard, the 7 block option would appear to be superior to the other

options examined thus far. While the "7 block" closure does not produce as much "other" salmon bycatch savings as the "9 block" option, it reduces the total area potentially impacted by the closure. Furthermore, this closure reduction is achieved by maintaining access to two blocks immediately above Unimak Island, fishing areas which could be assumed to have particular importance to the smaller, less mobile segments of the industry, thus diminishing any disproportionate burden from the closure.

Therefore, Option 6 provides for significant potential savings in "other" salmon bycatch (e.g., 59% of the total 'B' season "other" salmon interception in 1993), although as noted, not as great a potential savings as, for example, Option 5. It does, however, reduce the total area of the (potential, under Alternative 3) closure when compared to options 1, 2, 3, 4, and 5, although it may close a somewhat larger total area than options 1b and 2b. The smaller the area of closure, the less potential displacement and disruption of the domestic trawl fleet, ceteris paribus. Option 6 also reduces the potential disproportionate burden placed on the smaller and/or "shore-side processor" dependent segment of the fleet, by focusing the closures in blocks which are relatively more distant from the "horseshoe" and near-shore fishing areas along the chain. And it would be expected to have a relatively smaller potential adverse effect (and therefore reduced economic impact) on total groundfish catch, than do the other options thus far evaluated.
For example, NMFS annual groundfish trawl surveys suggest that pollock are present in relative abundance throughout the proposed 7 block area under option 6. Regarding pollock of commercial size, i.e., > 34 cm, the NMFS survey data show commercial concentrations within the "7 block" area, in each of the years 1989 through 1993, examined (see survey diagram, Figures 44 - 55). These same data confirm that significant concentrations of commercial-size pollock are also present outside of the seven block closure area, both within the CVOA and outside its boundaries. Because this closure option includes a relatively large portion of the total CVOA, its closure, either for the entire year (as under Alternative 2), or until October 15 (as under Alternative 3), would substantially diminish the area within the CVOA available to the industry. For operations with the capability to move beyond the boundaries of the CVOA, this may not create a serious operational problem. As the annual trawl survey data seem to suggest, commercial concentrations of pollock, during the 'B' season are widely distributed across the eastern Bering Sea. For smaller, less mobile vessels, and those dependent upon onshore processing capacity, the larger the size of the area of the CVOA effected by a closure, the greater the potential adverse operational and economic impacts. An area closure of the size of that proposed under the "7 block" option would impose costs on all those operations which, in the absence of the closure, would have fished these areas. The smaller, less mobile segment of the fleet may be most vulnerable to these costs, although it is not possible to predict the likelihood or magnitude of such adverse impacts, a priori. Nonetheless, it is important to be aware that such impact could accrue, when comparing the potential economic and socioeconomic outcomes of these several competing options.

While pollock stock concentrations are highly variable over time and geographic location, the surveys, which are undertaken in the early summer each year, also suggest that these seven blocks consistently contain large concentrations of pollock in the CVOA during the 'B' season. That is, closure of these specific seven blocks, either under Alternative 2 or Alternative 3, would be expected to result in substantial reductions of total pollock catches from the CVOA. As the survey diagrams indicate, in each year between 1989 and 1993, high concentrations of "marketable sized" pollock in the CVOA were found within the 7 block closure area. While commercially important concentrations were found outside these seven blocks, foregone pollock catches from a closure of the area defined under this option possibly could not be easily made up by shifting to the remaining areas of the CVOA. It may be possible for the more highly mobile elements of the fleet to make up some or all of their foregone catches outside of the CVOA. This might not be possible for the less mobile and/or "shore-side processor" dependent segments of the domestic catcher fleet.

By using 1993 catch data, by block, and 1993 exvessel values, under Alternative 2 (closure of these 7 blocks for the entire year), the foregone groundfish harvest could be worth an amount as yet to be determined. Under Alternative 3, this option could result in foregone catches that could reach a value which similarly requires future compilation. In the case of Alternative 3, this should be regarded as an upper-bound estimate, since almost certainly, some portion of the projected foregone catch would be made up from areas outside the CVOA and/or from blocks within the CVOA not effected by this closure option. It is not possible, a priori, to predict these amounts with precision. It is, however, appropriate to acknowledge that such impacts may accrue, should the 7 block option be adopted by the Council.

The following examination of Option 7 will suggest that adoption of Option 6, the 7 block closure option, while relatively superior to options 1 through 5, would not yield the greatest "net benefit to the Nation", among the range of options being considered, under either Alternative 2 or Alternative 3.

Option 7: "5 blocks". The five blocks approximating the north-central portion of the CVOA which includes the two Unimak Island blocks (Figure 6).

These five blocks were chosen, on the basis of historical catch and bycatch data from NMFS observer program sources, as a "minimum closure area" capable of yielding potentially significant "other" salmon savings in the pollock 'B' season, while at the same time still allowing access to the economically important "horseshoe" area of the CVOA, and not disproportionately burdening the smaller, less mobile segment of the industry. Although reduced in area from Option 5, this option accounted for between 1/3 and more than 1/2 of the total annual "other" salmon bycatch. During the period of July through October, the five block closure area accounted for very insignificant shares, i.e., .4%, 1%, .8%, and 7%, of the total annual groundfish catch in 1990, 1991, 1992 and 1993, respectively. During the same period, these five blocks accounted for 33%, 38%, 40%, and 54% of the total annual "other" salmon bycatch, respectively. This is a very favorable "tradeoff", between (potentially) foregone groundfish catches and (potential) "other" salmon bycatch savings.

Specifically, these statistics suggest that, all else equal, the cost of closing these specific five blocks, particularly under Alternative 3, as measured by foregone groundfish catch, appears relatively small as compared to the potential benefits, as measured in "other" salmon bycatch savings. When compared to the "next best" option assessed thus far, i.e., Option 5, the Option 7 (5 blocks) closure option, 1) significantly reduces the total area (potentially) affected by a closure, thus minimizing fishery disruptions, and associated dislocation costs, and retaining the greatest possible operational flexibility for the domestic trawl fleet operating within the CVOA; 2) reduces the size of the potential loss in directed groundfish catch by leaving open blocks within the CVOA which NMFS surveys indicate contain commercial concentrations of pollock; 3) retains the distributional balance between the smaller, less mobile and the more highly mobile sectors of the domestic fleet operating within the CVOA, during the pollock 'B' season; and 4) maintains access to supplies of raw fish for the "CVOA adjacent" shore-based processing sector.

As suggested above, NMFS annual groundfish trawl surveys suggest that pollock are present throughout a wide portion of the CVOA, in relatively significant concentrations. When selecting for fish of commercial size, i.e., > 34 cm, the NMFS survey data show commercial concentrations within the five block area, in each of the years 1989 through 1993, examined (see survey diagram, Figures 44 - 55).

While pollock stock concentrations are highly variable over time and geographic location, the surveys, which are undertaken in the early and mid-summer each year, also suggest that these five blocks do

not contain the largest concentrations of pollock in the CVOA during the 'B' season, largely because the size of the area encompassed has been reduced. That is, closure of these five blocks, either under Alternative 2 or Alternative 3, would not be expected to result in substantial reductions of total pollock catches from the CVOA. As the survey diagrams indicate, in each year between 1989 and 1993, the large concentrations of "marketable sized" pollock in the CVOA were found to the east and south of the 5 block closure area. This suggests that any pollock catches foregone as a result of the 5 block closure could, most probably, be made up from other areas of the CVOA. While operating costs might rise for those operations forced to relocate following a closure, the relative abundance of pollock in areas of the CVOA unaffected by this closure option should keep reductions in total catch to a minimum.

The five block option, among all the options considered here, also minimizes the potential impacts of a closure on the smaller and/or "shore-side processor" dependent sectors of the domestic pollock fleet by avoiding closures near the "horseshoe" and immediately adjacent to the chain. In this way, the five block option maintains the "level playing field" between the larger and more mobile segment of the industry and the smaller, less mobile catcher vessels, especially those delivering to shoreside plants.

This option does, however, reduce the potential savings in "other" salmon bycatch by reducing the total area available for closure. "Other" salmon are somewhat broadly distributed across the CVOA (as are pollock), and the potential for high bycatch could still exist in spite of a closure under this option, although the bycatch under this option should be much reduced from the status quo.

Preliminary examination of 1993 ADF&G fish tickets indicates that, at least five out of seven shoreside processing plants received some pollock harvested within the five blocks which comprise this option's closure area during the 1993 pollock 'B' season. Harvests within the five block area represented about 10 percent of the total 1993 'B' season pollock harvests by trawl catcher vessels delivering to shoreside processing plants.

Closure of the five block area, under Alternative 3, would only occur after July 1 or after a cap such as the 42, 000 "other" salmon bycatch limit for 1994 was attained. The closure would exclude all vessels using trawl gear, no matter what the target species, from the five block area until October 15. This would, therefore, potentially affect trawl operations which did not (and, presumably, would not) contribute to the interception of "other" salmon. If significant non-pollock groundfish trawl catches must be foregone as a result of this closure, for no measurable increase in bycatch reduction, costs may exceed potential benefits. However, examination of 1993 catch information indicates that no significant amounts of other groundfish fishing (or pollock Community Development Quota fishing, for that matter), occurred in these five blocks subsequent to closure of the directed inshore and offshore component pollock fisheries.

Further, this closure would not be expected to significantly affect the total harvest of pollock, under the 'B' season TAC. Most of the area within the CVOA that is currently available to the catcher vessels would remain open to pollock fishing, under this option. Based on 1993 'B' season fishing patterns, Option 7, the 5 block closure, would have resulted in relocation of catcher vessels within the Bering Sea for less than 10 percent of their pollock harvests.

3.4 Reporting Costs

Additional reporting costs would result if Alternative 3 were chosen with the option of implementing a cap. Under this alternative NMFS would need to monitor the cap an a daily basis which would entail daily reporting from motherships and shoreside plants. The vessels and the plants would incur

costs from the daily transmission of bycatch numbers. Time/area closures under the other alternatives, without a cap being established, would not result in additional reporting costs.

3.5 Administrative, Enforcement and Information Costs

Time/area closures that are set by calendar dates rather than the attainment of a specified bycatch limit avoid costs to both the industry and management agencies associated with the intensive inseason monitoring of salmon bycatch that would be required to project when a bycatch limit will be reached so that an associated the time/area closure can be made effective in a timely manner. Administrative costs associated with inseason monitoring of bycatch for purposes of triggering an inseason time/area closure include the processing of daily observer reports; costs associated with reviewing and verifying bycatch projections prior to imposing a time area closure, including drafting and publishing a closure notice in the Federal Register; and providing sufficient media notice of the inseason effective date of a time/area closure.

3.6 Summary of Economic Impacts

Alternative 1, or the "Status Quo" alternative, provides no mechanism, whatsoever, for the Secretary to address the potentially serious conservation and economic problem of "other" salmon bycatch in the pollock 'B' season trawl fishery in the CVOA. As a result, retention of Alternative 1 could potentially impose significant costs, in the form of excessive and uncontrollable "other" salmon bycatches in these fisheries. As suggested above, to the extent that these "other" salmon are of U.S.-origin, losses of the magnitude observed in 1993 represent a potentially significant economic loss to U.S. salmon fishing interests, including commercial, recreational, and subsistence users. If a substantial number of the "other" salmon lost to bycatch in these trawl fisheries are chums of Western Alaska origin, continued removals of the magnitude observed in the 1993 fisheries could potentially represent a severe conservation problem for some of this region's chum stocks. This would impose even greater costs, not only in terms of direct economic losses, but also in terms of social and cultural impacts to Western Alaska communities which are highly dependent on subsistence use of chums (among other species) for stability and survival.

Retention of Alternative one (the Status Quo) would, therefore, impose the risk of unacceptably high social, economic, conservation, and management costs on the Nation.

Alternative 2, provides the Secretary with the management authority to respond to excessively high "other" salmon bycatches, in the BSAI groundfish trawl fisheries, by closing specific areas to all trawling activity. Closures would, almost certainly, reduce the "other" salmon bycatch loss. To the extent that these "other" salmon bycatch savings accrue to U.S.-origin stocks, there would be a benefit to the Nation from such savings. Because of the absence of source-of-origin data on the bycaught salmon, it is not possible to predict the size or distribution of such savings. However, due to the considerable mixing of "other" salmon stocks in the area of the interceptions, it is reasonable to conclude that a reduction in total trawl bycatch of "other" salmon would benefit U.S.-origin stocks. To the extent that the savings to U.S.-origin stocks included chums from Western Alaska, the benefits would be proportionately greater, since these stocks are, at present, at below average levels of abundance and productivity. In addition, because of the high level of dependence on several Western Alaska salmon stocks by subsistence (and particularly Native American) users and communities, savings would also yield social and cultural benefits, in addition to the economic benefits identified.

Alternative 2 does, however, impose potentially significant costs, in the form of foregone groundfish harvests, fleet dislocation (and potential idleness for some plants and vessels unable to adjust to season-long closures). These costs would tend to offset the potential benefits, identified above, from

reducing "other" salmon interceptions. Because Alternative 2 would close a specified area of the BSAI to all trawling from January 1 through December 31, adoption of this alternative would result in unnecessarily restrictive groundfish management over periods of the year when "other" salmon bycatch is not a problem. That is, Alternative 2 would impose very significant costs, in the form of foregone groundfish harvest, displacement, and idleness of capacity, with no offsetting benefits, in the form of salmon savings, over substantial portions of the fishing year.

While Alternative 2 does provide the Secretary with the ability to address potentially excessive bycatches of "other" salmon in the BSAI groundfish trawl fisheries (and is, therefore, superior to retention of the Status Quo, in that respect), it is not the "least costly" means of achieving the objectives of the Council, among the alternatives considered. Furthermore, because of the uncertainty as to size and distribution of "benefits" to U.S.-origin stocks from a reduction in CVOA trawl bycatch, but a clearly substantial potential "cost" to the U.S. groundfish harvesting sectors from a total closure, a positive "net benefit to the Nation" of adoption of this alternative is not assured.

Alternative 3 provides the Secretary with in-season management authority to respond to excessive trawl bycatch interceptions of "other" salmon in the BSAI management areas. It does so, however, in a more judicious manner than is proscribed in Alternative 2. Specifically, when the annual "other" salmon bycatch in the CVOA either reaches a set cap, or if bycatch occurs during the period of high salmon bycatch (July - October), a specified area of the BSAI will be closed to all trawling until October 15. In April of 1994, the Council took emergency action and set a cap of 42,000 "other" salmon to close a specific area to all trawling through the expiration of the ER. This alternative is less exclusionary than Alternative 2 because it closed a specified area only after a salmon bycatch limit had been reached in the CVOA. The cap of 42,000 salmon represents 50 percent of the 1991, 1992 and 1993 average of "other" salmon caught in the CVOA, and is not expected to be a serious constraint in a year when "other" salmon bycatches are of average historical magnitudes. That is, if the very high 1993 bycatches of "other" salmon were an anomaly, the 42,000 fish cap under Alternative 3 should impose no costs on the groundfish sector, and will, on average, not increase costs on the salmon users. If 1993 bycatches were not an anomaly, the 42,000 "other" salmon cap will afford relative protection against bycatch losses of the size observed in that year, ceteris paribus. To the extent that bycatch savings accrue to U.S.-origin stocks, while reductions in U.S. pollock catches are minimized, benefits can be anticipated from adoption of this alternative. The greater the number of "other" salmon from Western Alaska sources represented in the bycatch savings, the greater the potential benefit to the Nation, ceteris paribus.

Under Alternative 3, to facilitate the monitoring of a salmon cap, motherships and some shoreside processors that receive groundfish harvested in the CVOA during the pollock 'B' season would need two observers onboard until either, 1) the cap is reached or, 2) NMFS determines that salmon bycatch rates are sufficiently low to make daily observer reports unnecessary. Under existing regulations, each processor that receives fish caught in the CVOA must have one observer who is required to count all salmon that have been caught. To monitor the "other" salmon cap, NMFS would need daily reports of the "other" salmon numbers, as well as haul by haul statistics. The time required to count bycaught salmon and transmit this data on a daily basis would place an extra burden on those observers who are in processing facilities that receive a large number of deliveries.

Therefore, under the proposed Alternative 3, two observers would be required on each mothership receiving pollock caught in the CVOA during the 'B' season and at each shoreside processor that offloads fish at more than one location on the same dock that has distinct and separate equipment at each location to process those fish and that receives pollock caught in the CVOA during the pollock 'B' season. This would ensure accurate and timely counts of salmon bycatch, without compromising the other monitoring and reporting duties of the observer.

Direct costs for observer coverage are estimated to be about $200 per day per observer. The cost of a second observer on motherships and appropriate shoreside processing plants would depend on the number of days the additional observer was required. The number of observer days for each mothership operating in the CVOA during the 1993 'B' season ranged from 39 to 58 days. Based on the observer coverage requirements for 1993, a second observer during the 1994 'B' season could cost from $7,800 (39 days x $200/day) to $11,600 (58 days x $200/day) per mothership given that the observer was required for the entire 'B' season. Associated cost for an extra observer could be much lower if, as in 1994, the closure occurred after the first week of the season. The extra observer would not be covered under the Research Plan and the facilities would not receive credit for those costs in 1995. For 1996 and beyond observer coverage requirements would be annually specified under the Research Plan.

Under the ER, hardware and software acquisition has previously been incurred by most vessels and plants processing in 1994; although some minor changes to the requirements have been made for this amendment. Processors that do not have all of the necessary equipment would be required to acquire the specified hardware and software. Under the ER a PC with a 386 or better processing chip and 5 megabytes of free hard disk storage was required; however under this amendment a 486 processing chip with 10 megabytes free hard disk storage and 8 megabytes RAM would be required for both motherships and shoreside processing plants. For observers to provide daily reports, NMFS would require that all motherships that receive fish caught in the CVOA during the pollock 'B' season provide INMARSAT Standard A satellite communication capabilities and associated software (cc mail remote and a data entry program provided by the Regional Director) for observers' use. Each mothership must also have available for observers' use a personal computer (PC) with a 486 or better processing chip, a DOS version 3.0 operating system or better and 10 megabytes free hard disk storage with 8 megabytes RAM.

Under this alternative, each shoreside facility that receives pollock harvested in the CVOA during the pollock 'B' season, and that is required to have 100 percent observer coverage, would be required to have the capability to transmit data over telephone lines using a computer modem. These processors would be required to make available to observers a PC with a 486 or better processing chip, with at least a 9600 Baud modem and a phone line. The PC needs to be equipped with Windows 3.1 and have at least 10 megabytes of free hard disk storage and 8 megabytes RAM. The affected processors will also be required to obtain for observers' use the data entry software program provided by the Regional Director. The NMFS Observer Program Office may provide installation of the software programs to both motherships and shoreside processors.

The alternative that is least exclusive, while assuring equitable treatment for the groundfish fisheries, and yet offers some protection to "other" salmon is Alternative 3, Option 7. In combination then, Alternative 3, with Option 7, provide the greatest potential "net benefit to the Nation", among all the alternatives, options, and sub-options under consideration by the Council.

4.0 INITIAL REGULATORY FLEXIBILITY ANALYSIS

The objective of the Regulatory Flexibility Act is to require consideration of the capacity of those affected by regulations to bear the direct and indirect costs of regulation. If an action will have a significant impact on a substantial number of small entities an Initial Regulatory Flexibility Analysis (IRFA) must be prepared to identify the need for the action, alternatives, potential costs and benefits of the action, the distribution of these impacts, and a determination of net benefits.

NMFS has defined all fish-harvesting or hatchery businesses that are independently owned and operated, not dominant in their field of operation, with annual receipts not in excess of $2,000,000

as small businesses. In addition, seafood processors with 500 employees or less, wholesale industry members with 100 employees or less, not-for-profit enterprises, and government jurisdictions with a population of 50,000 or less are considered small entities. A "substantial number" of small entities would generally be 20% of the total universe of small entities affected by the regulation. A regulation would have a "significant impact" on these small entities if it resulted in a reduction in annual gross revenues by more than 5 percent, annual compliance costs that increased total costs of production by more than 5 percent, or compliance costs for small entities that are at least 10 percent higher than compliance costs as a percent of sales for large entities.

If an action is determined to affect a substantial number of small entities, the analysis must include:

(1) description and estimate of the number of small entities and total number of entities in a particular affected sector, and total number of small entities affected; and

(2) analysis of economic impact on small entities, including direct and indirect compliance costs, burden of completing paperwork or recordkeeping requirements, effect on the competitive position of small entities, effect on the small entity's cashflow and liquidity, and ability of small entities to remain in the market.

4.1 Economic Impact on Small Entities

Most trawl vessels and processors participating in the BSAI groundfish fishery would be affected by the management measures proposed under Alternatives 2 or 3 that would authorize time/area closures of varying magnitude to limit chum salmon bycatch in the BSAI trawl fisheries.

Most catcher vessels harvesting groundfish off Alaska meet the definition of a small entity under the RFA. In 1993, 132 trawl catcher vessels landed groundfish from the BSAI. Most of these vessels would be affected by time/area closures considered under Alternative 2 or 3, particularly those vessels that participate in the pollock fishery. The economic impact on small entities that would result from some of the year-round time/area closures considered under Alternative 2 (e.g., closure of the CVOA or area 517) could result in a reduction in annual gross revenues by more than 5 percent and could, therefore, potentially have a significant economic impact on a substantial number of small entities. Other time/area closures considered under Alternative 2 or the seasonal closures under Alternative 3 would be less likely to result in a reduction in annual gross revenues by more than 5 percent, annual compliance costs that increased total costs of production by more than 5 percent, or compliance costs for small entities that are at least 10 percent higher than compliance costs as a percent of sales for large entities.

5.0 REFERENCES

ADF&G (Alaska Department of Fish and Game). 1993. Report to the Governor's RAVEN (Rural Alaska Village Economies and Needs) Commission, October, 1993.

ADF&G (Alaska Department of Fish and Game). 1993b. Subsistence chum salmon harvests Chignik, Alaska Peninsula, Bristol Bay, and A-Y-K areas. Division of Subsistence, ADF&G, November 1993. IN: Staff Reports, Special Board of Fisheries Meeting, December 1-4, 1993. Anchorage, AK.

ADF&G (Alaska Department of Fish and Game). 1994. Salmon Fisheries in the Yukon Area, Alaska 1993. Alaska Department of Fish and Game RIR No. 3A94-05. IN: ADF&G 1994 Western Alaska Finfish Reports. Board Meeting March 1994, Alaska Board of Fisheries, ADF&G.

Andrews, Elizabeth and Michael W. Coffing. 1986. Kuskokwim River subsistence chinook fisheries: an overview. Technical Paper No. 146. Alaska Department of Fish and Game, Division of Subsistence, Juneau.

Berger, J., J. Wall, and R. Nelson Jr. 1984. Summary of U.S. observer sampling of foreign and joint-venture fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1983. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Vancouver, B.C., Canada, October 1984). Northwest and Alaska Fisheries Science Center, National Marine Fish. Serv., NOAA, Seattle, Washington.

Burch, E.S. Jr. 1984. The central Yupik Eskimos: an introduction. Etudes Inuit Studies 8:3-19.

Coachman, L.K., T.H. Kinder, J.D. Schumacher, and R.B. Tripp. 1980. Frontal systems of the southeastern Bering Sea shelf. IN: Second International Symposium on Stratified Flows. Vol.2, T. Carstens and T. McClimans, eds., Trondheim, Tapir, pp. 917-933.

Eggers, D.M., K. Rowell, and B.Barrett. 1989. Stock composition of sockeye and chum salmon in the 1987 South Peninsula, Alaska, June fishery based on completed tag data. (INPFC Doc.) Alaska Department of Fish and Game, Juneau. 68 pp.

Fienup-Riordan, A. 1983. The Nelson Island Eskimo: social structure and ritual distribution. Alaska Pacific University Press, Anchorage.

Francisco, K.R., C. Anderson, C. Burkey, and D. Molyneaux. 1994. Report to the Alaska Board of Fisheries, Kuskokwim Area, 1993. Alaska Department of Fish and Game RIR No. 3A94-03. CFMD, ADF&G, Bethel, Alaska.

Fredin, R.A., R.L. Major, R.G. Bakkala, and G.Tanonaka. 1977. Pacific salmon and the high seas salmon fisheries of Japan. (Processed report.) Northwest and Alaska Fisheries Center, National Marine Fisheries Service, Seattle, WA. 324 p.

Guttormsen, M., R. Narita, and J. Berger. 1990. Summary of U.S. observer sampling of foreign and joint venture fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1989. NOAA Tech. Mem. NMFS F/NWC-189.

Jacobson, S. A. 1984. Yup'ik Eskimo dictionary. University of Alaska, Alaska Native Language Center, Fairbanks.

The Joint United States/Canada Yukon River Technical Committee. February 24-25, 1993. "Yukon River Joint Technical Committee Report". Anchorage, Alaska. pp. 12.

McRoy, C.P., D.W. Hood, L.K. Coachman, J.J. Walsh and J.J. Goering. 1985. Processes and resources of the Bering Sea shelf (PROBES): the development and accomplishments of the project. Continental Shelf Research, Vol. 5, Nos 1/2, pp 5-21.

Meyers, K.W., R.V. Walker, S. Fowler, and M.L. Dahlberg. 1990. Known ocean ranges of stocks of Pacific salmon and steelhead as shown by tagging experiments, 1956-1989. (INPFC Doc.) FRI-UW-9909. Fish. Res. Inst., Univ. Washington, Seattle.

National Marine Fisheries Service (NMFS). 1995a. Final Environmental Assessment for 1995 Groundfish Total Allowable Catch Specifications. NMFS, P.O. Box 21668, Juneau, AK 99802-1668.

National Marine Fisheries Service (NMFS). 1994. Biological Opinion on the Effects of the North Pacific Groundfish Fisheries on Salmon. January 19, 1994. 28p. National Marine Fisheries Service, P.O. Box 21668, Juneau, AK 99802-1668.

National Marine Fisheries Service (NMFS). 1995b. Status of Incidental Salmon Catches for 1995 in the Grounfish Fisheries off Alaska, January 25, 1995. National Marine Fisheries Service, P.O. Box 21668, Juneau, AK 99802-1668.

National Marine Fisheries Service (NMFS). 1995c. Decision Memorandum on the Bering Sea and Aleutian Islands and Gulf of Alaska 1995 Total Allowable Catch Specifications. February 3, 1995. National Marine Fisheries Service, P.O. Box 21668, Juneau, AK 99802-1668.

North Pacific Fisheries Management Council. 1993. Draft for public review, Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Amendment 21b (Salmon bycatch management) to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands. March 18, 1993.

Ogura, M., and S. Ito. 1994. Change in the known ocean distribution of Japanese chum salmon, Oncorhynchus keta, in relation to the progress of stock enhancement. Can. J. Fish. Aquat. Sci. 51:501-505.

Pacific Fishing. June 1994.

Rogers, D.E.1994. False Pass chum salmon, 1993. FRI-UW-9404. Fish. Res. Inst, Univ. Washington, Seattle.

Shinkwin, A. and M. Pete. 1984. Yupik Eskimo societies: a case study. Etudes Inuit Studies 8:95-112.

Sumida, V. A. and D. B. Andersen. 1990. Patterns of fish and wildlife use for subsistence in Fort Yukon, Alaska. Technical Paper No. 179, Alaska Department of Fish and Game, Division of Subsistence, Juneau.

United States Fish and Wildlife Service (USFWS). 1989. Formal Consultation with the US Fish and Wildlife Service Pursuant to Section 7 of the Endangered Species Act. Biological Opinion. July 3, 1989. National Marine Fisheries Service, P.O. Box 21668, Juneau, AK, 99802-1668.

United States Fish and Wildlife Service (USFWS). 1994. Informal consultation with the U.S. Fish and Wildlife Service Pursuant to Section 7 of the Endangered Species Act. February 14, 1994. National Marine Fisheries Service, P.O. Box 21668, Juneau, AK 99802-1668

United States Fish and Wildlife Service (USFWS). 1995. Amendment to the 1989 Biological Opinion Pursuant to Section 7 of the Endangered Species Act. February 7, 1995. National Marine Fisheries Service, PO Box 21668, Juneau AK 99802-1668

Wolfe, R. J. 1984. Commercial fishing in the hunting-gathering economy of a Yukon River Yup'ik Society. Etudes Inuit Studies 8:159-183.

Wolfe, R. J. et al.1984. Subsistence-based economies in coastal communities of Southwest Alaska. Technical Paper No. 89, Alaska Department of Fish and Game, Division of Subsistence, Juneau.

Wolfe, R. J. and R. J. Walker. 1987. Subsistence economies in Alaska: productivity, geography, and development impacts. Arctic Anthropology 24(2):56-81.

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7.0 ACKNOWLEDGEMENTS

In addition to the preparers, Robert Wolfe of ADF&G, Subsistence Division, composed the section "The importance of chinook salmon in the traditional cultures and socioeconomic systems of the Yup'ik Eskimos and Athabaskan indians of western and interior Alaska" in the socioeconomic section. Jerry Berger, Ren Narita and Karma Nelson of the National Marine Fisheries Service, Alaska Fisheries Science Center provided the trawl fisheries observer data and related information.

LIST OF TABLES

Bering Sea Trawl "Other Salmon" Bycatch Statistics for 1992 - 1994

	Trawl "Other Salmon" Bycatch		Trawl "Other Salmon" Bycatch Rate (salmon/mt of groundfish)		
	Annual Total	"B" Season Total	"B" Season Rate	Rate Jun 1- Aug 15	Rate After Aug 15
1992 "B" Season = Jun 1	41,345	38,320	0.05	0.02	0.08
1993 "B" Season = Aug 15	243,261	229,899	0.30		
1994 "B" Season = Aug 15	75,908*	51,565*	0.08		
1994 "Other Salmon" Statistics					
CVOA	61,686*	43,567*	0.35		
SALMON SAVINGS AREA	n.a.	8,723	1.12		
NON-CVOA	14,222*	7,998*	0.03		

* 1994 Bycatch Statistics (except Salmon Savings Area) are projections based on data through August 27, 1994.

Table 1. Bering Sea trawl "other" salmon bycatch statistics for 1992-1994. Note that 1994 estimates are actual counts after August 13, 1994.

Data from Mike Sloan NMFS 9/16/94

Table 2. Guideline harvest levels and commercial and subsistence catch for the summer and fall run chum salmon on the Yukon River, 1993.

Summer Chum Salmon - Yukon River - 1993

District or Subdistrict	Guideline Harvest Range Lower	Mid-point	Upper	1993 Catch Commercial	Subsistence
1 and 2	251,000	503,000	755,000	92,991	59,282
3	6,000	12,500	19,000	463	3,355
4A	113,000	225,500	338,000	38,196	24,259
4B,C	16,000	31,500	47,000	4,761	
5	1,000	2,000	3,000		11,086
6	13,000	25,500	38,000	3,705	7,434
Total Alaska	400,000	800,000	1,200,000	140,116	105,416

Fall Chum Salmon - Yukon River - 1993

District or Subdistrict	Guideline Harvest Range Lower	Mid-point	Upper	1993 Catch Commercial	Subsistence
1,2 and 3	60,000	140,000	220,000	0	12,102
4B,C	5,000	22,500	40,000	0	11,043
5A,B,C	4,000	20,000	36,000	0	43,764
5D	1,000	2,500	4,000	0	
6	2,750	11,625	20,500	0	9,951
Canada	21,300	21,800	30,300	7,762	4,590
Total Alaska	72,750	196,625	320,500	0	76,860
Total	94,050	218,425	350,800	7,762	81,450

Note that there was no directed commercial fishing for summer chums in districts 2,3,5, or 6. Subsistence districts do not exactly conform to commercial subdistricts in districts 4 or 5 so data have been pooled to represent all of district 4 or 5.

Table 3. Tribal and linguistic affiliation of Kuskokwim River communities fishing Kuskokwim Drainage salmon stocks.

TRIBAL AND LINGUISTIC AFFILIATION OF KUSKOKWIM RIVER COMMUNITIES. FISHING KUSKOKWIM DRAINAGE SALMON STOCKS.

Native Non-Profit Organization		
Association of Village Council Presidents	Kuskokwim Native Association	Tanana Chiefs Conference, Inc.
Linguistic Affiliation		
Central Yup'ik	*Central Yup'ik; Athabaskan*	*Upper Kuskokwim Athabaskan*
IRA-Traditional Council Government		
Kipnuk	Lower Kalskag	McGrath
Kwigillingok*	Upper Kalskag	Takotna
Kongiganak	Aniak	Nikolai
Eek	Chuathbaluk	Telida
Tuntutuliak*	Crooked Creek	
Kasigluk	Red Devil	
Nunapitchuk*	Sleetmute	
Atmauthuak	Stony River	
Napakiak*	Lime Village	
Napaskiak		
Oscarville		
Bethel		
Kwethluk*		
Akaichak*		
Akiak*		
Tuluksak*		

*Tribal government established under the Indian Reorganization Act (48 Stat. 984; 49 Stat. 1250).

Source: Andrews Elizabeth and Daniel E Albrecht "Participation in and Contribution to Fisheries Management By Alaskan Tribal Groups: Case Examples From the Salmon Fisheries of the Yukon and Kuskokwim Rivers " Paper presented at the American Fisheries Society 122nd Annual Meeting Rapid City South Dakota September 14 17 1992

Table 4. Tribal and linguistic affiliation of Yukon River communities fishing Yukon Drainage salmon stocks.

TRIBAL AND LINGUISTIC AFFILIATION OF YUKON RIVER DRAINAGE COMMUNITIES. FISHING YUKON DRAINAGE SALMON STOCKS.

Native Non-Profit Organization		
Association of Village Council Presidents	Tanana Chiefs Conference, Inc.	Council of Athabaskan Tribal Governments
Linguistic Affiliation		
Central Yup'ik	*Athabaskan*	*Gwich'in Athabaskan*
IRA-Traditional Council Government		
Kotlik	*Ingalik Athabaskan*	Stevens Village*
Sheldon Point	Holy Cross	Beaver
Alakanuk	Anvik	Birch Creek
Emmonak	Shageluk*	Fort Yukon*
Mountain Village		Venetie
Pitka's Point		Arctic Village*
St. Mary's	*Holikachuk Athabaskan*	Chalkyitsik
Pilot Station	Grayling*	Circle
Marshall		
Russian Mission	*Koyukon Athabaskan*	
	Kaltag*	
	Nulato	
	Koyukuk	
	Huslia	
	Hughes	
	Allakaket	
	Galena	
	Ruby	
	Tanana*	
	Rampart	
	Manley	
	Inupiaq Eskimo	
	Alatna	
	Evansville	
	Tanana Athabaskan	
	Minto*	
	Nenana	
	Han Athabaskan	
	Eagle	

*Tribal government established under the Indian Reorganization Act (48 Stat. 984; 49 Stat. 1250).

Source: Andrews and Albrecht Sept 1992

Amend.21b

Table 5. Communities using subsistence chum and chinook salmon within the Yukon, Kuskokwim and Bristol Bay areas: 1990 U.S. Census population, ethnicity, housing and income.

Communities Using Subsistence Chinook Salmon within the Yukon, Kuskokwim, and Bristol Bay Areas: 1990 U.S. Census Population, Ethnicity, Housing and Income

Source: ADFG Division of Subsistence, Community Profile Database, July 1992

	1990 U.S. Census			
Community	Population	Percent Native	Number of Households	Median Household Income
Yukon River Drainage				
Alakanuk	544	95.8	121	$17,708.00
Alatna	31	93.6	13	$11,477.00
Allakaket	138	94.3	46	$11,477.00
Anvik	82	91.5	32	$10,694.00
Arctic Village	96	93.8	36	$9,861.00
Beaver	103	95.2	43	$20,313.00
Bettles	36	22.2	19	$38,333.00
Birch Creek	42	90.5	15	$5,032.00
Chalkyitsik	90	92.2	33	$12,750.00
Circle	73	86.3	23	$17,083.00
Eagle	168	3.0	66	$12,500.00
Eagle Village	35	80.0	20	$11,875.00
Emmonak	642	92.1	161	$25,625.00
Evansville	33	57.6	13	$29,167.00
Fairbanks	42092	8.9	14649	$32,033.00
Fort Yukon	580	85.0	205	$17,969.00
Galena	833	45.2	190	$28,611.00
Grayling	208	93.3	51	$21,641.00
Holy Cross	277	93.5	86	$13,750.00
Hughes	54	92.6	22	$15,833.00
Huslia	207	90.8	62	$13,333.00
Kaltag	240	92.5	63	$15,500.00
Kotlik	461	96.9	101	$20,417.00
Koyukuk	126	97.6	40	$13,929.00
Manley Hot Springs	96	14.6	46	$31,250.00
Marshall (Fortuna Ledge)	273	92.7	70	$28,750.00
Minto	218	97.3	66	$17,656.00
Mountain Village	674	91.1	148	$26,750.00
Nenana	393	47.8	140	$27,292.00
Nulato	359	96.9	90	$17,143.00
Pilot Station	463	95.0	100	$16,000.00
Pitka's Point	135	95.6	37	$17,813.00
Rampart	68	94.1	24	$15,000.00
Ruby	170	74.1	61	$15,000.00
Russian Mission	246	94.7	56	$21,667.00
Saint Marys (Andreafsky)	441	82.9	118	$28,542.00
Scammon Bay	343	96.5	85	$15,179.00
Shageluk	139	94.9	42	$16,250.00
Sheldon Point	109	92.7	27	$16,250.00
Stevens Village	102	91.2	37	$10,000.00
Tanana	345	78.3	123	$17,000.00
Venetie	182	93.9	50	$14,688.00

Amend.21b

Table 5 (continued)

Communities Using Subsistence Chinook Salmon within the Yukon, Kuskokwim, and Bristol Bay Areas: 1990 U.S. Census Population, Ethnicity, Housing and Income

Source: ADFG Division of Subsistence, Community Profile Database, July 1992

	1990 U.S. Census			
Community	Population	Percent Native	Number of Households	Median Household Income
Kuskokwim River Drainage				
Akiachak	483	95.0	112	$23,750.00
Akiak	285	97.2	67	$13,571.00
Aniak	540	70.7	159	$32,841.00
Atmautluak	258	96.9	53	$15,833.00
Bethel	4674	63.9	1432	$42,232.00
Chuathbaluk	97	89.7	28	$13,750.00
Crooked Creek	106	90.6	33	$16,250.00
Eek	254	95.7	72	$21,000.00
Goodnews Bay	241	95.8	66	$13,523.00
Kasigluk	425	95.3	89	$28,563.00
Kongiganak	294	97.3	60	$33,250.00
Kwethluk	558	96.4	127	$16,000.00
Kwigillingok	278	95.0	62	$14,500.00
Lime Village	42	95.2	14	$9,257.00
Lower Kalskag	291	98.3	67	$10,357.00
McGrath	528	46.9	175	$36,250.00
Napakiak	318	94.3	81	$18,125.00
Napaskiak	328	94.8	74	$18,750.00
Nikolai	109	88.9	40	$11,250.00
Nunapitchuk	378	97.1	87	$17,083.00
Oscarville	57	91.2	15	$26,250.00
Platinum	64	92.2	22	$23,056.00
Red Devil	53	50.9	18	$25,000.00
Quinhagak	501	93.8	127	$17,500.00
Sleetmute	106	86.8	33	$10,000.00
Stony River	51	88.2	19	$5,156.00
Takotna	38	44.7	15	$18,750.00
Telida	11	90.9	3	
Tuntutuliak	300	96.7	70	$14,444.00
Upper Kalskag	172	84.9	48	$16,250.00
Bristol Bay Area				
Aleknagik	185	83.2	57	$21,875.00
Clark's Point	60	88.3	18	$17,083.00
Dillingham	2017	55.8	691	$44,083.00
Egegik	122	70.5	48	$20,625.00
Ekwok	77	87.0	30	$10,833.00
Igiugig	33	78.8	13	$41,250.00
Iliamna	94	65.9	30	$41,250.00
King Salmon	696	15.5	158	$54,072.00
Kokhanok	152	90.1	38	$14,286.00

Amend.21b

Table 5 (continued)

Communities Using Subsistence Chinook Salmon within the Yukon, Kuskokwim, and Bristol Bay Areas: 1990 U.S. Census Population, Ethnicity, Housing and Income

Source: ADFG Division of Subsistence, Community Profile Database, July 1992

	1990 U.S. Census			
Community	Population	Percent Native	Number of Households	Median Household Income
Koliganek	181	96.1	47	$18,125.00
Levelock	105	82.9	39	$12,159.00
Manokotak	385	95.6	90	$20,500.00
Naknek	575	41.0	208	$50,907.00
Nelson Lagoon	83	80.7	31	$44,583.00
New Stuyahok	391	95.9	88	$12,083.00
Newhalen	160	94.4	36	$26,250.00
Nondalton	178	89.3	54	$21,750.00
Pedro Bay	42	90.5	17	$38,125.00
Pilot Point	53	84.9	17	$36,750.00
Port Alsworth	55	1.8	17	$36,250.00
South Naknek	136	79.4	39	$23,750.00
Togiak	613	87.3	151	$15,000.00
Twin Hills	66	92.4	25	$11,667.00
Ugashik	7	85.7	4	

Amend.21b

Table 6. Subsistence harvests by community and year for selected surveyed communities, pounds (useable weight) per person per year.

Subsistence Harvests by Community and Year For Select Surveyed Communities, Pounds (Usable Weight) Per Person Per Year

Source: ADFG Division of Subsistence, Community Profile Database, July 1

Community	Study Year	Chinook Harvest Lbs Per Person	Total Subsistence Harvest Lbs Per Person
Yukon River Drainage			
Allakaket/Alatna	82	43	906
Beaver	85	157	732
Bettles/Evansville	82	3	260
Fort Yukon	87	227	999
Galena	85	61	787
Hughes	82	112	1492
Huslia	83	21	1082
Minto	84	56	1015
Stebbins	80	201	1007
Stevens Village	84	335	1139
Alakanuk	80	73	728
Emmonak	80	80	613
Kotlik	80	45	511
Mountain Village	80	72	822
Russian Mission	85	135	**
Kuskokwim River Drainage			
Chuathbaluk	83	131	727
Kwethluk	86	193	836
McGrath	84	21	182
Nikolai	84	103	787
Nunapitchuk	83	140	802
Quinhagak	82	138	768
Sleetmute	83	20	402
Tununak	86	23	1093
Bristol Bay Area Villages			
Clark's Point	89	79	363
Egegik	84	21	384
Ekwok	87	178	797
Iliamna	83	1	416
Ivanof Bay	89	2	490
Kokhanok	83	4	697
Koliganek	87	74	830
Levelock	88	25	1253
Manokotak	85	30	384
Nelson Lagoon	87	11	258
New Stuyahok	87	199	700
Newhalen	83	3	767
Nondalton	83	2	1175
Pedro Bay	82	9	865
Pilot Point	87	22	384
Port Heiden	87	24	408

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Subsistence Harvests by Community and Year For Select Surveyed Communities, Pounds (Usable Weight) Per Person Per Year

Source: ADFG Division of Subsistence, Community Profile Database, July 1

Community	Study Year	Chinook Harvest Lbs Per Person	Total Subsistence Harvest Lbs Per Person
Bristol Bay Area Villages (Continued)			
South Naknek	83	32	288
Ugashik	87	65	814
Bristol Bay Area Regional Centers			
Dillingham	84	53	242
King Salmon	83	56	220
Naknek	83	31	188

Table 7. Percentage of households fishing for salmon for subsistence in 1990 and 5-year average of subsistence salmon harvests by community and species along the Yukon River drainage in Alaska, 1986-90.

Community	Percent of Households Fishing in 1990	Average Chinook Harvest 1986-90	Average Summer Chum Harvest 1986-90	Average Fall Chum Harvest 1986-90	Average Coho Harvest 1986-90
Alakanuk	43.9	927.2	9,511.6	1,533.9	751.6
Alatna	38.5	42.0	6,883.2	1,563.4	74.0
Allakaket	30.4	350.7	a	a	a
Anvik	43.8	499.4	17,103.4	438.8	214.8
Beaver	25.6	905.8	b	b	b
Bettles	28.1	b	b	b	b
Birch Creek	b	b	b	b	b
Chuloyitsik	18.2	0.0	83.4	1,955.4	160.2
Circle	42.0	1,973.4	1,029.2	5,606.0	60.0
Eagle	40.7	2,099.6	627.4	14,090.2	4.0
Eagle Village	40.7	c	c	c	c
Emmonak	51.6	1,905.8	14,504.6	3,178.2	1,669.8
Evansville	28.1	b	b	b	b
Fort Yukoft	20.0	3,545.4	2,814.8	13,185.2	332.4
Galena	52.6	1,761.2	6,756.6	5,854.8	766.0
Graying	17.7	1,191.2	19,036.4	2,589.8	626.0
Holy Cross	38.4	2,487.6	1,983.2	1,045.8	430.2
Hughes	45.5	154.6	10,765.2	1,133.0	148.2
Huslia	24.2	145.2	3,658.0	529.8	47.6
Kaltag	61.9	1,383.0	12,879.4	3,154.4	304.4
Kotlik	54.5	2,104.4	10,546.8	3,502.6	1,700.4
Koyukuk	30.0	753.6	3,383.2	1,718.8	266.0
Manley Hot Springs	60.9	732.8	1,939.2	13,408.6	3,645.2
Marshall (Fortuna Ledge)	57.1	1,699.5	4,436.4	2,710.2	1,903.4
Minto	25.8	361.0	1,225.4	3,476.8	1,614.6
Mountain Village	57.4	1,630.4	11,796.2	3,186.2	1,752.4
Nenana	24.3	2,343.8	8,629.2	21,799.2	10,612.4
Nulato	61.1	2,048.2	7,610.2	2,323.4	301.8
Pilot Station	56.0	2,000.6	5,974.4	1,486.2	1,007.4
Pitka's Point	35.1	400.8	2,231.0	469.2	402.4
Rampart	62.5	2,463.6	1,470.8	5,186.4	342.2
Ruby	73.8	1,083.8	4,574.8	6,644.6	910.2
Russian Mission	48.2	1,938.8	2,517.6	845.8	482.8
Saint Mary's (Andreafsky)	40.7	2,042.4	9,874.6	2,496.0	1,838.6
Shageluk	28.6	59.6	7,772.8	161.6	74.6
Sheldon's Point	44.4	597.5	3,115.2	545.4	255.8
Stevens Village	43.2	2,431.2	1,894.6	4,728.8	271.6
Tanana	34.2	2,904.4	10,031.0	42,372.4	8,478.2
Venetie	26.0	56.6	146.2	3,871.0	73.4
TOTAL	41.8	46,756.8	206,928.2	179,900.2	45,304.0

Source: Alaska Department of Fish and Game, Div. of Commercial Fisheries, Annual Management Reports, 1986-90.

a\ Harvests combined with Allakaket. b\ Information not collected. c\ Harvests combined with Eagle.

Table 8. 1991 Alaskan Yukon River drainage subsistence harvests.

Villages	Estimation Method b/	Total Households or permits Issued	Households Contested or permits Returned	Estimated Harvest			
				Chinook	Summer Chum	Fall Chum	Coho
Sheldon Point	Survey	21	17	445	2,226	84	35
Alakanuk	Survey	121	36	1,044	8,058	193	391
Emmonak c/	Survey	138	51	1,311	8,401	2,020	801
Kotlik d/	Survey	100	34	3,125	9,105	1,637	581
District 1 Subtotal		380	138	5,925	27,790	3,935	1,808
Mt. Village	Survey	130	43	1,171	4,743	1,473	868
Pitka's Pt.	Survey	21	18	652	1,452	610	347
St. Marys	Survey	73	37	1,836	7,832	1,592	1,270
Pilot Station e/	Survey	100	38	2,681	4,634	1,062	553
Marshall	Survey	59	27	1,277	2,042	891	259
District 2 Subtotal		383	163	7,617	20,703	5,628	3,297
Russian Mission	Survey	51	24	1,349	837	425	396
Holy Cross	Survey	46	22	1,649	1,028	190	944
District 3 Subtotal		97	46	2,998	1,865	615	1,340
Anvik	Survey	31	19	619	876	452	347
Shageluk	Survey	23	15	189	3,680	0	0
Grayling	Survey	52	32	874	8,094	3,616	1,363
Kaltag	Survey	54	28	1,866	2,287	2,834	1,260
Nulota	Survey	90	26	2,500	159	1,637	75
Koyukuk	Survey	42	18	885	2,326	2,761	307
Galena	Survey	179	44	2,574	3,493	5,525	422
Ruby	Survey	66	25	971	1,352	2,856	410
District 4 Subtotal		537	207	10,478	22,267	19,681	4,184
Tanana	Survey	122	50	2,483	2,779	40,868	4,448
Rampart	Survey	25	22	988	20	5,801	58
Stevens Village	Survey	30	26	2,035	1,385	2,481	0
Beaver	Survey	35	30	713	2,355	7	0
Ft. Yukon	Survey	222	50	5,585	11,974	7,467	380
Birch Creek	Survey	13	8	196	0	0	1
Circle	Permit	22	21	1,720	51	6,340	5
Central	Permit	7	7	151	0	73	0
Chicken	Permit	2	2	0	0	0	0
Eagle	Permit	35	35	1,193	607	7,985	0
District 5 Subtotal		513	251	15,064	19,171	71,022	4,892

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Table 8 (continued)

Villages	Estimation Method b/	Total Households or permits Issued	Households Contested or permits Returned	Estimated Harvest			
				Chinook	Summer Chum	Fall Chum	Coh
Manley	Permit	30	27	518	1,729	13,243	6,3
Minto	Permit	34	26	134	748	5,276	5
Nenana f/	Permit	49	47	1,654	1,499	17,932	10,1
Healy	Permit	7	7	0	0	2,059	1,9
Fairbanks NSB	Permit	200	190	1,360	2,164	3,693	2,5
Delta Junction g/	Permit	15	9	0	0	46	
Tok	Permit	8	8	139	19	101	
Tanana R. Subtotal		343	314	3,805	6,159	42,350	21,5
Other Subtotal h/	Permit	14	12	66	10	241	
Huslia	Survey	61	23	198	7,857	411	1
Hughes	Survey	18	16	146	1,257	270	
Alatna	Survey	13	11	5	962	38	
Allakaket	Survey	43	22	446	6,451	475	
Bettles	Survey	24	13	16	155	0	
Koyukuk R. Subtotal		159	85	811	16,682	1,194	2
Venetie	Survey	63	19	9	3,393	758	
Chulkyitsik	Survey	32	26	0	500	100	
Chandmiar/Black R. Subtotal		95	45	9	3,893	858	
	Survey Total	2,098	870	39,838	111,713	88,535	15,80
	Permit Total	423	391	6,935	6,827	56,989	21,58
Alaska Yukon River Drainage Total		2,521	1,261	46,773	118,540	145,524	37,38

a/ Source: Estimation of Subsistence Salmon Harvests in the Yukon River Drainage 1991 (draft, April 1992) Jeffrey F. Bromaghin and Helen H. Hammer, Alaska Dept. of Fish & Game. Harvest ar listed by fisherma community of residence.

b/ Does not include permit information received after April 20, 1992.

c/ Includes 661 chinook, 2,519 summer chum, 1,620 fall chum, and 761 coho harvested in ADF&G test fishery a given away for subsistence use.

d/ Includes 869 chinook, 3,103 summer chum, 854 fall chum, and 334 coho harvested in ADF&G test fishery a given away for subsistence use.

e/ Includes 262 chinook, 984 summer chum, 505 fall chum, and 234 coho harvested in ADF&G test fishery and giv away for subsistence use.

f/ Includes 112 chinook, 98 summer chum, 777 fall chum harvested in ADF&G test fishery and given away f subsistence use.

g/ Does not include a harvest of 741 post-spawned fall chum salmon.

h/ Includes information from permits issued to residents of other communities who fished the Upper Yukon Are

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Table 9 1991 Kuskokwim Area Subsistence Salmon Harvests

Community	Households			CHINOOK		CHUM		SOCKEYE		COHO	
	Total	Contacts	Reported Fishing	Reported Harvest	Est'd Total Harvest	Reported Harvest	Est'd Total Harvest	Reported Harvest	Est'd Total Harvest	Reported Harvest	Est'd Total Harvest
Kipnuk	95	5	4	44	44	15	15	38	38	30	30
Kwigillingok	33	0	0	0	0	0	0	0	0	0	0
Kongiganak	57	54	38	497	533	633	679	303	325	345	370
North Kuskokwim Bay Totals	185	59	42	541	577	648	694	341	363	375	400
Tuntutuliak	60	57	52	3,997	3,997	4,620	4,620	1,646	1,646	723	723
Eek	69	54	46	2,516	2,881	734	843	479	552	401	457
Kasigluk	82	76	53	2,366	2,566	2,737	2,972	1,152	1,249	1,561	1,687
Nunapitchuk	90	75	53	3,201	3,472	4,851	5,262	1,799	1,951	833	904
Atmautlauk	53	52	39	1,336	1,369	1,757	1,801	636	652	287	294
Napakiak	73	69	46	2,429	2,476	2,229	2,272	1,128	1,150	548	559
Napaskiak	70	64	43	2,901	2,961	4,939	5,042	2,038	2,080	583	595
Oscarville	17	13	10	1,088	1,088	567	567	506	506	95	95
Bethel	1,094	561	337	17,257	30,233	13,207	23,444	10,594	18,205	16,294	29,229
Kwethluk	134	127	91	6,864	7,072	4,776	4,921	3,454	3,559	2,121	2,185
Akiachak	106	102	78	4,429	4,547	4,641	4,764	3,257	3,344	1,836	1,887
Akiak	50	49	41	2,516	2,576	4,002	4,097	1,285	1,316	1,621	1,660
Tuluksak	70	67	54	2,730	2,780	4,613	4,697	2,923	2,976	1,537	1,567
Lower Kuskokwim Totals	1,968	1,366	943	53,630	68,018	53,673	65,302	30,897	39,186	28,440	41,842
Lower Kalskag	57	51	31	3,561	3,835	1,976	2,128	859	925	381	410
Upper Kalskag	41	35	25	777	841	1,971	2,129	219	237	358	387
Aniak	154	143	88	3,170	3,303	3,393	3,533	2,000	2,086	998	1,042
Chuathbaluk	29	27	17	672	672	1,625	1,625	1,059	1,059	79	79
Middle Kuskokwim Totals	281	256	161	8,180	8,651	8,965	9,415	4,137	4,307	1,816	1,918
Crooked Creek	30	28	18	941	1,027	1,036	1,130	923	1,007	174	190
Red Devil	16	15	11	84	92	618	674	213	232	566	617
Sleetmute	38	33	23	731	775	1,830	1,915	1,266	1,366	1,547	1,614

Table 9 (cont'd)

Community	Households			CHINOOK		CHUM		SOCKEYE		COHO	
	Total	Contacts	Reported Fishing	Reported Harvest	Est'd Total Harvest	Reported Harvest	Est'd Total Harvest	Reported Harvest	Est'd Total Harvest	Reported Harvest	Est'd Total Harvest
Stony River	19	18	11	537	537	552	552	1,753	1,753	460	460
Lime Village	13	10	5	43	50	511	596	683	797	240	280
McGrath	148	116	40	789	821	964	999	0	0	788	818
Takotna	17	17	0	0	0	0	0	0	0	0	0
Nikolai	31	30	14	316	316	371	371	0	0	62	62
Telida	3	0	0	0	0	0	0	0	0	0	0
Upper Kuskokwim Totals	315	267	122	3,441	3,618	5,882	6,237	4,838	5,155	3,837	4,041
Kuskokwim River Totals	2,749	1,948	1,268	65,792	80,864	69,168	81,648	40,213	49,011	34,468	48,201
Quinhagak	118	95	81	2,970	3,536	1,129	1,346	1,292	1,538	2,437	2,901
Goodnews Bay	70	63	36	632	664	97	102	743	780	1,164	1,222
Platinum	16	14	8	18	18	4	4	120	120	31	31
South Kuskokwim Bay Totals	204	172	125	3,620	4,218	1,230	1,452	2,155	2,438	3,632	4,154
Mekoryuk	49	6	6	0	0	1,178	9,620	1	8	130	1,062
Newtok	58	0	0	0	0	0	0	0	0	0	0
Nightmute	26	2	2	10	10	60	60	110	110	20	20
Toksook Bay	75	7	6	40	40	253	253	155	155	1	1
Tununak	86	1	1	10	10	0	0	100	100	0	0
Bering Sea Coast Totals	294	16	15	60	60	1,491	9,933	366	373	151	1,083
Anchorage	-	1	1	0	0	3	3	0	0	39	39
Kuskokwim Area Totals	3,247	2,137	1,409	69,472	85,142	71,892	93,036	42,734	51,822	38,290	53,477

Table 10. Percentage of annual groundfish catch and salmon bycatch taken within specific areas and within the months of July - October.

	Percentage of Annual Catch and Bycatch			Percentage of Annual Catch and Bycatch taken July - October		
Option 1 - CONTOUR	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	33.1%	61.2%	32.7%	13.9%	16.2%	31.8%
1991	46.3%	76.7%	48.7%	18.2%	3.2%	43.6%
1992	32.3%	34.1%	47.1%	14.9%	0.8%	45.6%
1993	41.3%	56.1%	32.4%	25.9%	16.6%	32.3%

Within 15 miles of 200 m contour

Option 1b - CONTOUR IN CVOA	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	16.4%	40.5%	29.1%	10.7%	14.3%	28.6%
1991	19.7%	59.1%	33.0%	6.4%	2.1%	31.8%
1992	15.9%	15.0%	38.3%	8.5%	0.7%	37.1%
1993	23.0%	27.8%	24.8%	17.9%	8.3%	24.7%

Within 15 miles of 200 m contour and ONLY within the CVOA

Option 2 - CONTOUR + UNIMAK	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	36.0%	75.5%	57.6%	14.2%	26.4%	56.5%
1991	52.4%	82.9%	83.7%	18.9%	3.3%	77.9%
1992	39.4%	54.4%	85.7%	15.3%	1.0%	77.2%
1993	56.8%	72.4%	55.2%	29.4%	18.4%	54.8%

Within 15 miles of 200 m contour and 2 blocks above Unimak Is.

Option 2b - CONTOUR + UNIMAK IN CVOA	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	19.3%	54.8%	54.0%	11.0%	24.6%	53.3%
1991	25.9%	65.3%	68.0%	7.1%	2.1%	66.1%
1992	22.9%	35.3%	76.9%	8.9%	0.9%	68.7%
1993	38.5%	44.1%	47.6%	21.3%	10.0%	47.1%

Within 15 mi of 200 m contour, 2 blocks above Unimak Is. and ONLY in CVOA

Option 3 - CVOA	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	24.9%	66.3%	77.6%	11.2%	31.8%	76.8%
1991	31.6%	70.6%	77.8%	7.6%	2.2%	75.5%
1992	36.9%	54.1%	82.1%	9.2%	0.9%	72.1%
1993	51.5%	55.1%	80.2%	25.9%	12.5%	79.6%

Catcher Vessel Operational Area

Option 4 - AREA 517	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	17.7%	47.0%	27.5%	7.9%	14.7%	26.8%
1991	17.3%	60.2%	40.5%	6.5%	2.1%	38.2%
1992	24.0%	30.3%	54.3%	8.6%	0.7%	53.4%
1993	51.1%	55.1%	88.0%	28.1%	14.0%	87.5%

NMFS Management Area 517

Option 5 - 9 BLOCKS	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	5.2%	22.0%	39.3%	0.6%	15.5%	39.1%
1991	9.4%	7.8%	45.1%	1.5%	0.6%	44.3%
1992	11.4%	28.2%	50.4%	1.3%	0.2%	43.3%
1993	27.2%	26.2%	67.8%	10.1%	5.4%	67.4%

Northern portion of CVOA and one block northwest of CVOA

Option 6 - 7 BLOCKS	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	2.0%	8.3%	14.1%	0.5%	5.6%	13.9%
1991	3.0%	5.7%	16.0%	1.2%	0.6%	15.6%
1992	3.1%	4.6%	24.3%	1.0%	0.1%	24.2%
1993	16.0%	16.4%	59.5%	8.0%	4.2%	59.1%

Northwestern portion of CVOA and one block northwest of CVOA

Option 7 - 5 BLOCKS	Total Catch	Chinook bycatch	Other bycatch	Total Catch	Chinook bycatch	Other bycatch
1990	3.5%	15.4%	33.6%	0.4%	10.4%	33.4%
1991	6.8%	6.9%	38.7%	1.0%	0.1%	38.0%
1992	8.2%	21.5%	47.1%	0.8%	0.2%	40.0%
1993	22.6%	22.2%	54.6%	7.1%	3.6%	54.3%

3 Blocks above Unimak Is. and 2 northwest of these

Table 11. Percentage of catch and bycatch in exclusive non-overlapping areas. Percentages are for entire year or for the months of July - October only.

Exclusive Areas - % of Annual Catch and Bycatch				Exclusive Areas - % of Catch and Bycatch, July - Oct only			
CONTOUR BUFFER IN CVOA ONLY							
	Total Catch	Chinook bycatch	Other bycatch		Total Catch	Chinook bycatch	Other bycatch
1990	16.4%	40.5%	29.1%	1990	23.6%	37.2%	29.7%
1991	19.7%	59.1%	33.0%	1991	16.6%	60.1%	34.3%
1992	15.9%	15.0%	38.3%	1992	30.5%	52.1%	41.8%
1993	23.0%	27.8%	24.8%	1993	36.5%	36.1%	24.8%
UNIMAK BLOCKS ONLY							
	Total Catch	Chinook bycatch	Other bycatch		Total Catch	Chinook bycatch	Other bycatch
1990	2.9%	14.3%	24.9%	1990	0.6%	26.5%	25.7%
1991	6.2%	6.2%	35.0%	1991	1.8%	0.7%	37.1%
1992	7.0%	20.3%	38.6%	1992	1.5%	12.4%	35.6%
1993	15.5%	16.3%	22.8%	1993	7.0%	7.8%	22.6%
REST OF CVOA - NOT IN CONTOUR BUFFER OR UNIMAK BLOCKS							
	Total Catch	Chinook bycatch	Other bycatch		Total Catch	Chinook bycatch	Other bycatch
1990	5.6%	11.5%	23.6%	1990	0.5%	18.7%	24.4%
1991	5.7%	5.3%	9.8%	1991	1.1%	2.2%	10.2%
1992	13.9%	18.8%	5.2%	1992	1.2%	1.9%	3.9%
1993	13.0%	11.1%	32.6%	1993	9.2%	10.7%	32.7%
CONTOUR BUFFER OUTSIDE CVOA							
	Total Catch	Chinook bycatch	Other bycatch		Total Catch	Chinook bycatch	Other bycatch
1990	16.7%	20.7%	3.6%	1990	7.0%	4.7%	3.3%
1991	26.5%	17.6%	15.7%	1991	30.3%	33.8%	12.7%
1992	16.4%	19.1%	8.8%	1992	23.1%	7.7%	9.6%
1993	18.3%	28.4%	7.6%	1993	16.3%	36.5%	7.7%
BERING SEA MINUS CVOA AND CONTOUR BUFFER							
	Total Catch	Chinook bycatch	Other bycatch		Total Catch	Chinook bycatch	Other bycatch
1990	58.4%	13.0%	18.8%	1990	68.3%	12.9%	17.0%
1991	41.9%	11.8%	6.5%	1991	50.2%	3.1%	5.7%
1992	46.7%	26.8%	9.1%	1992	43.7%	25.9%	9.2%
1993	30.2%	16.5%	12.2%	1993	31.0%	8.9%	12.2%

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Figure 14. Estimated commercial and subsistence catch of summer and fall run chum salmon on the Yukon River, and chum salmon on the Kuskokwim River (not entire Kuskokwim Area).

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Figure 1. Bering Sea with 200 m depth contour portrayed as a dashed line. A buffer extends 15 mi on each side of the contour. The two 1/2° latitude by 1° longitude "Unimak blocks" are blackened.

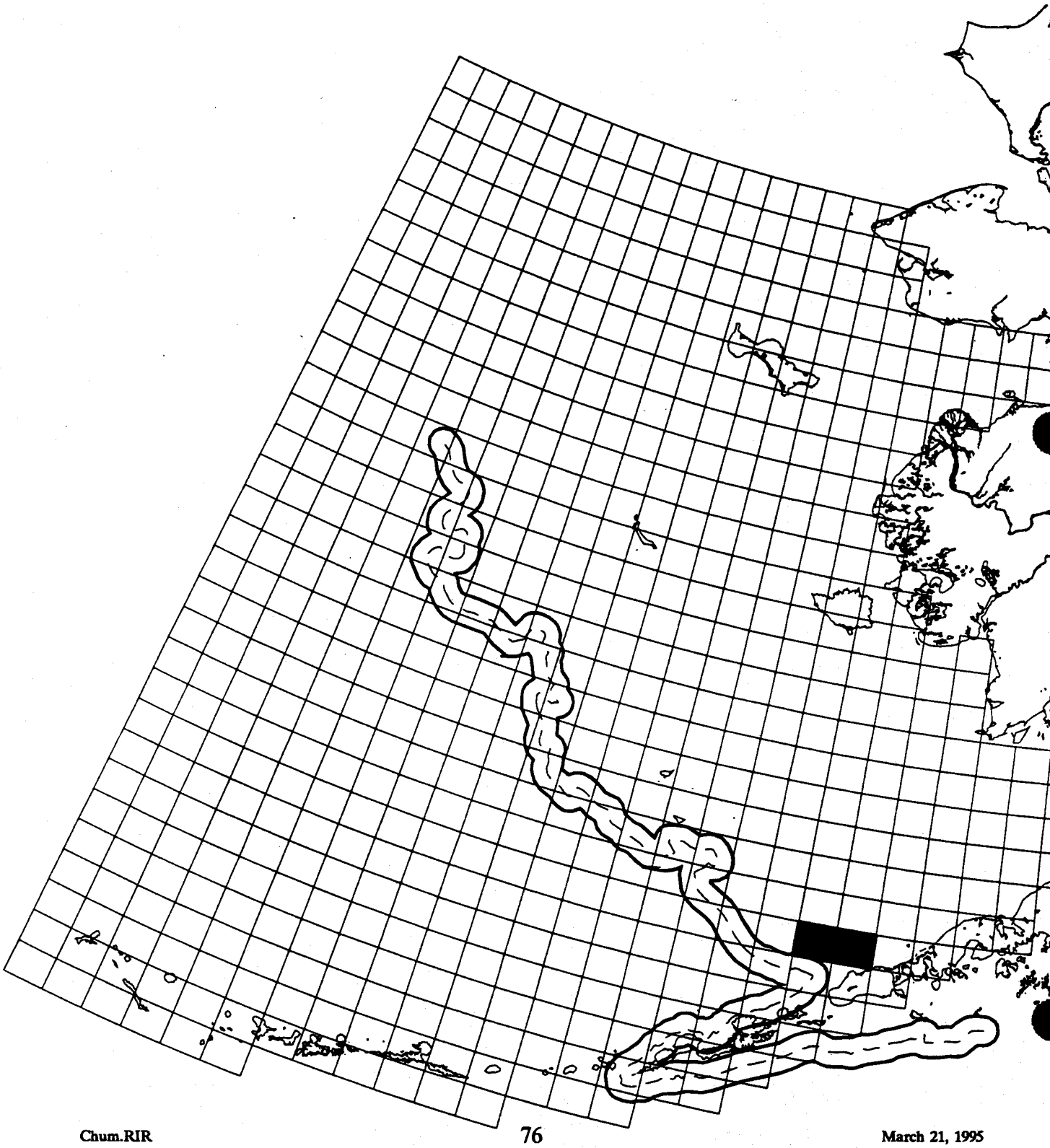


Figure 2. The location of the catcher-boat operational area (CVOA) in the Bering Sea. Northern boundary is 56° N latitude, western boundary is 168° W longitude, and eastern boundary is 163° W longitude.

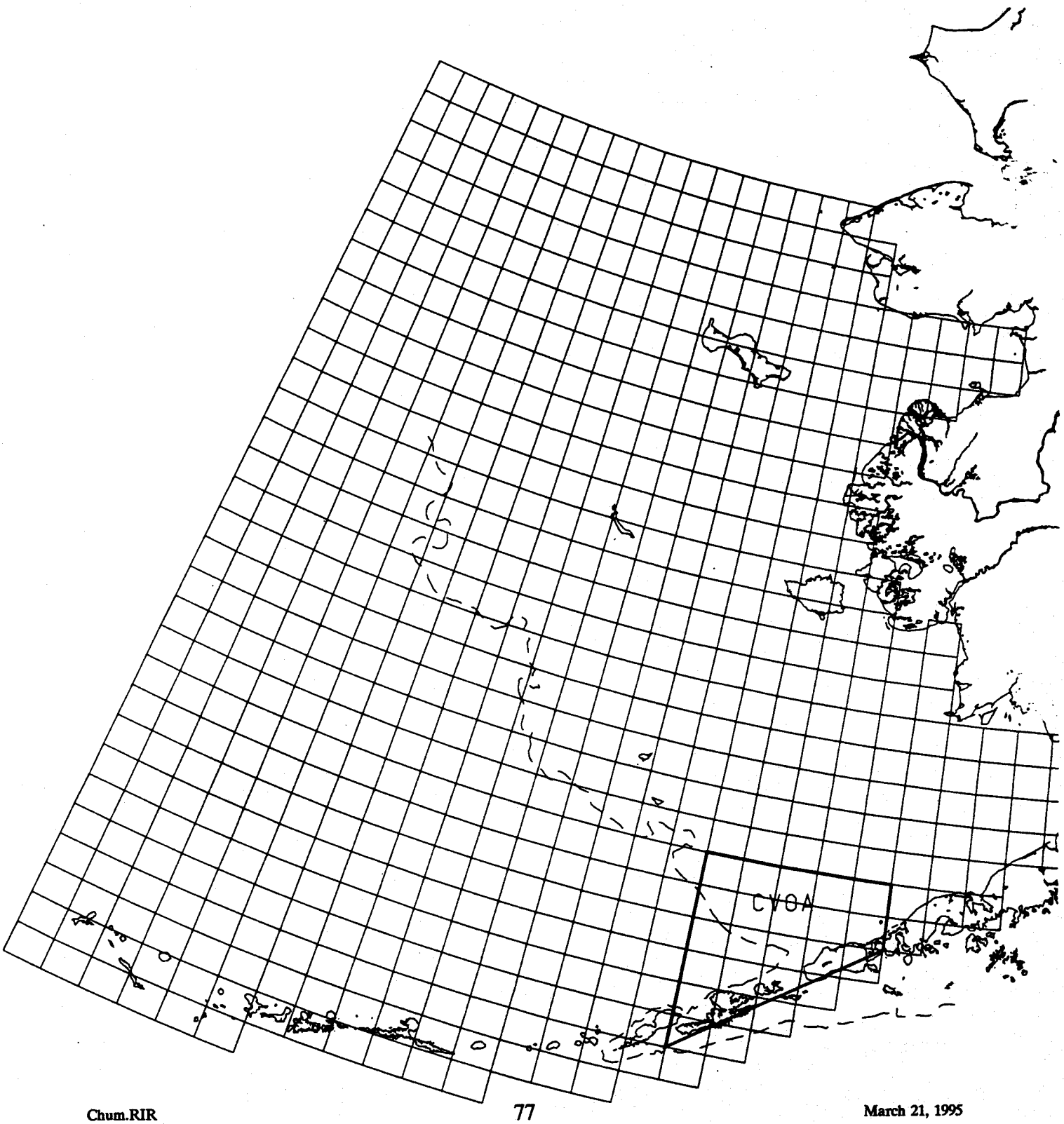


Figure 3. NMFS management areas with Area 517 highlighted.

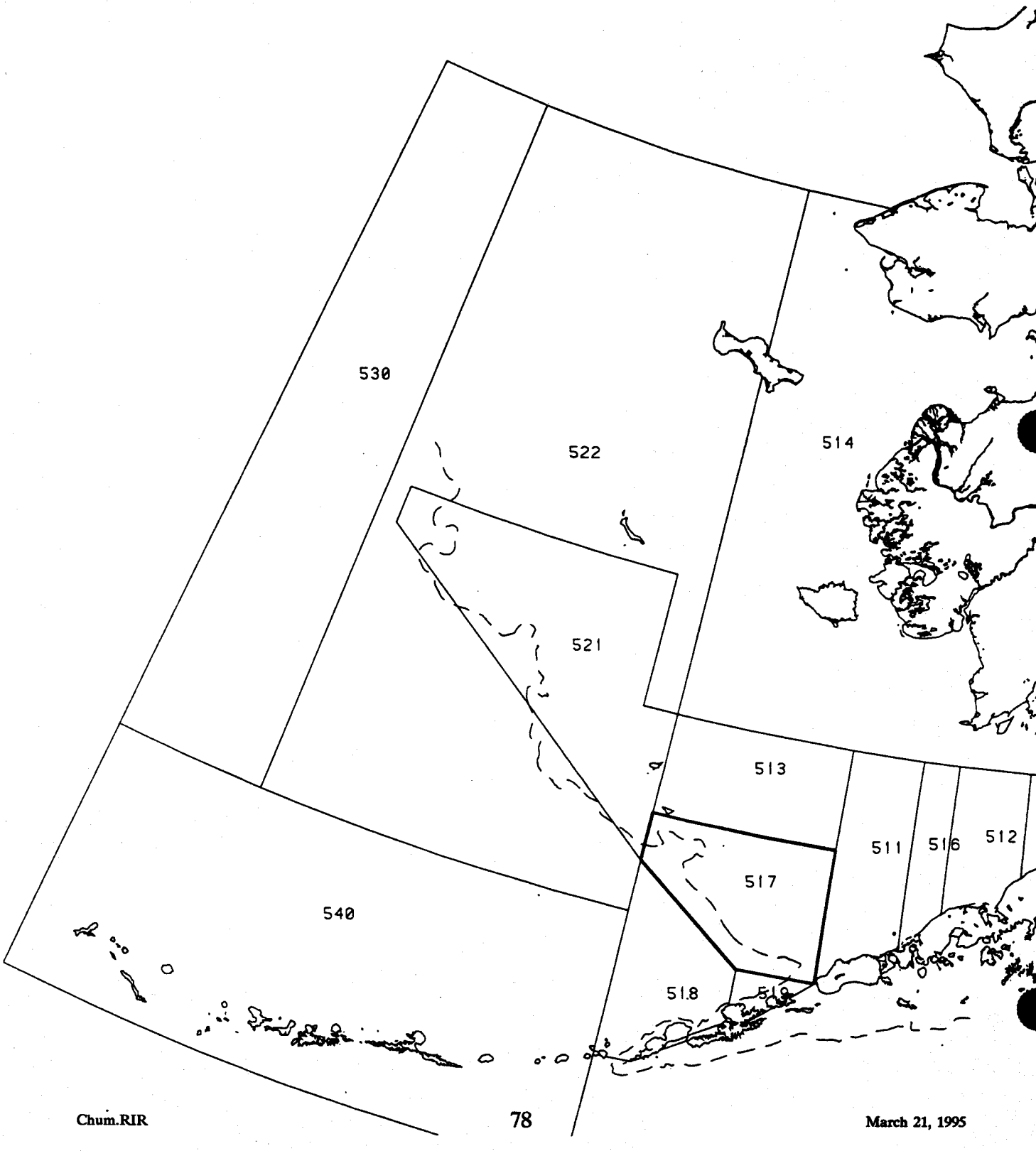


Figure 4. 9-Block option shaded, CVOA highlighted.

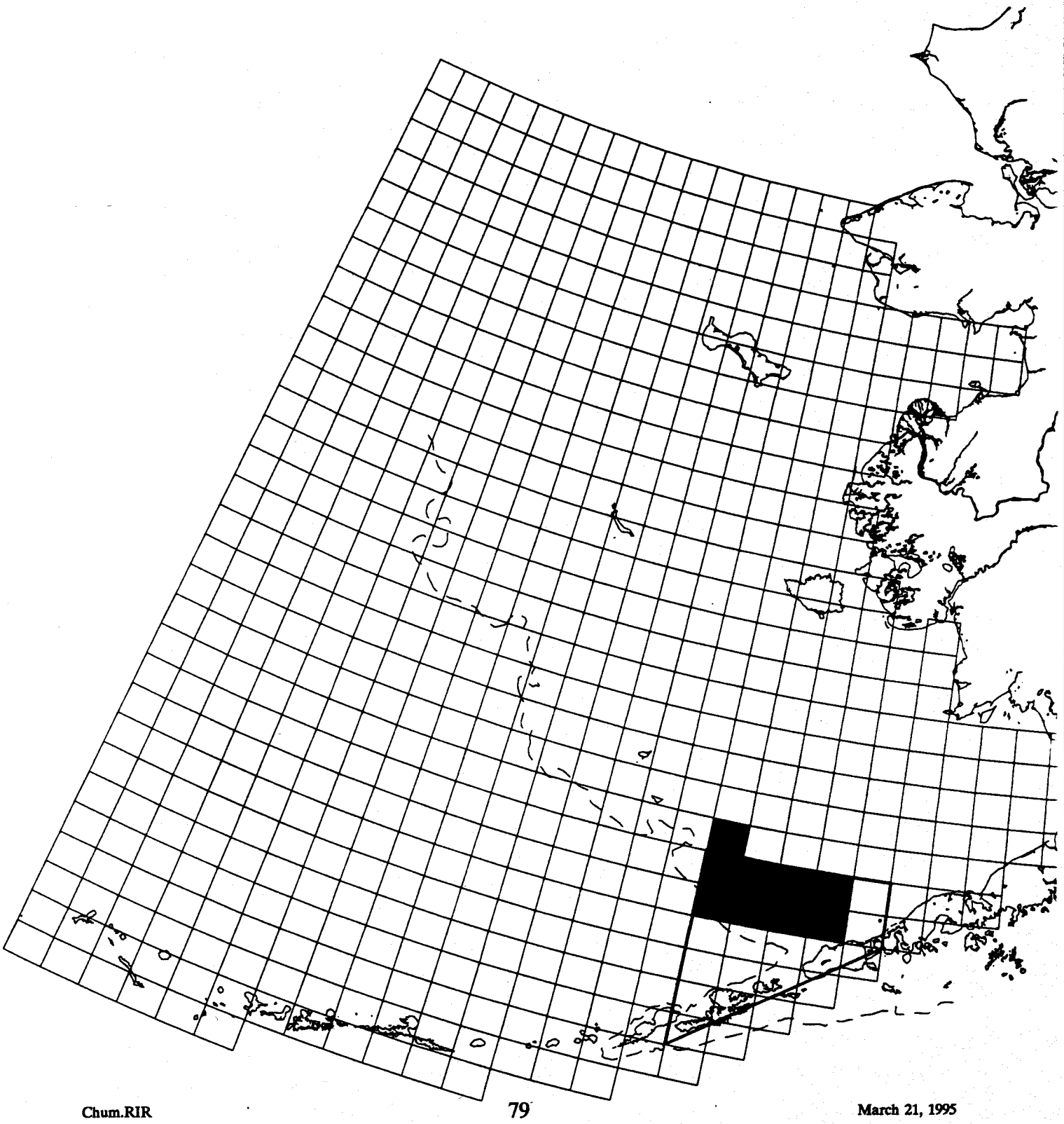


Figure 5. 7-Block option shaded, CVOA highlighted.

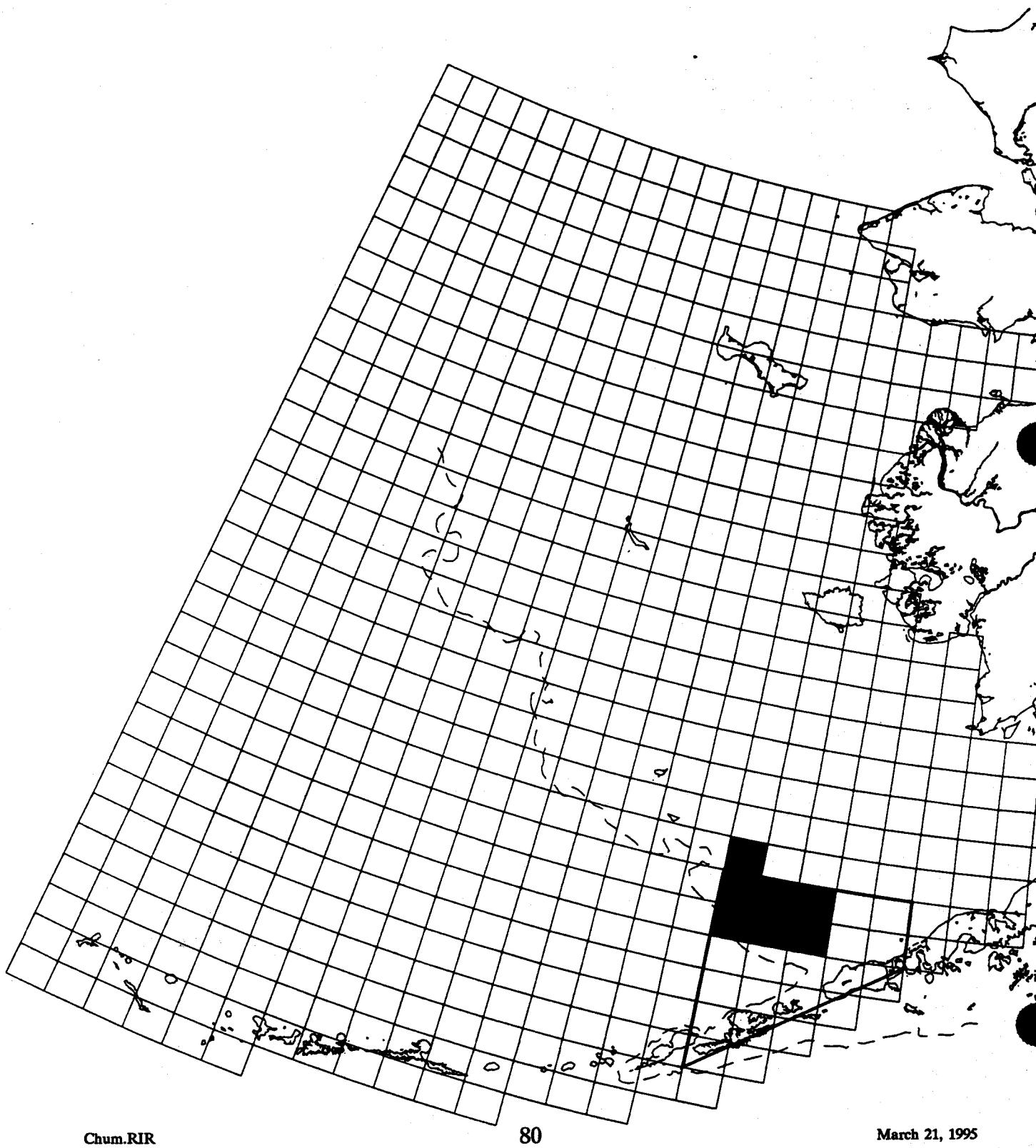


Figure 6. 5-Block option shaded, CVOA highlighted.

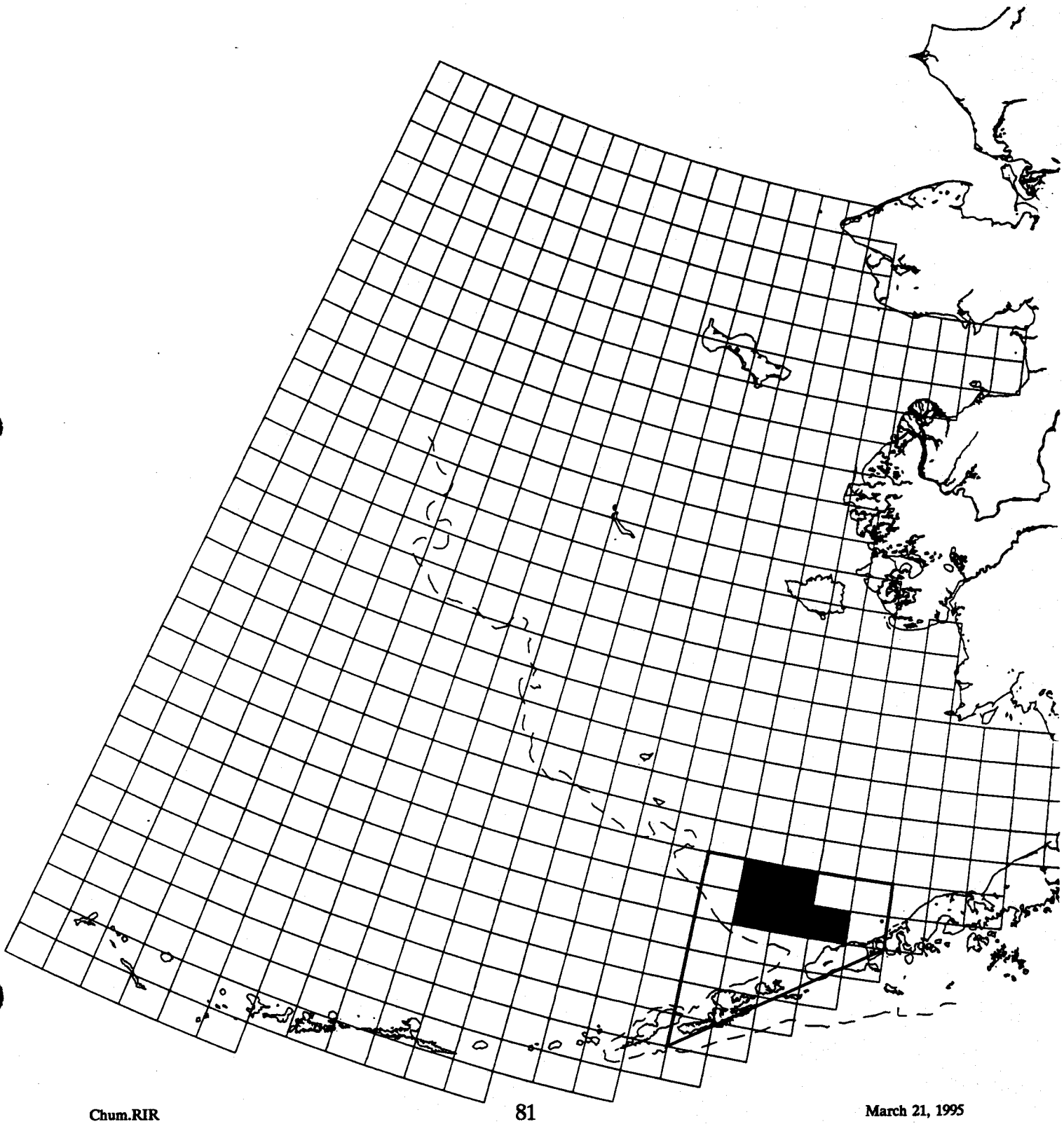


Figure 7. Areas chosen larger than 1/2° latitude by 1° longitude blocks for determining individual haul salmon species composition.

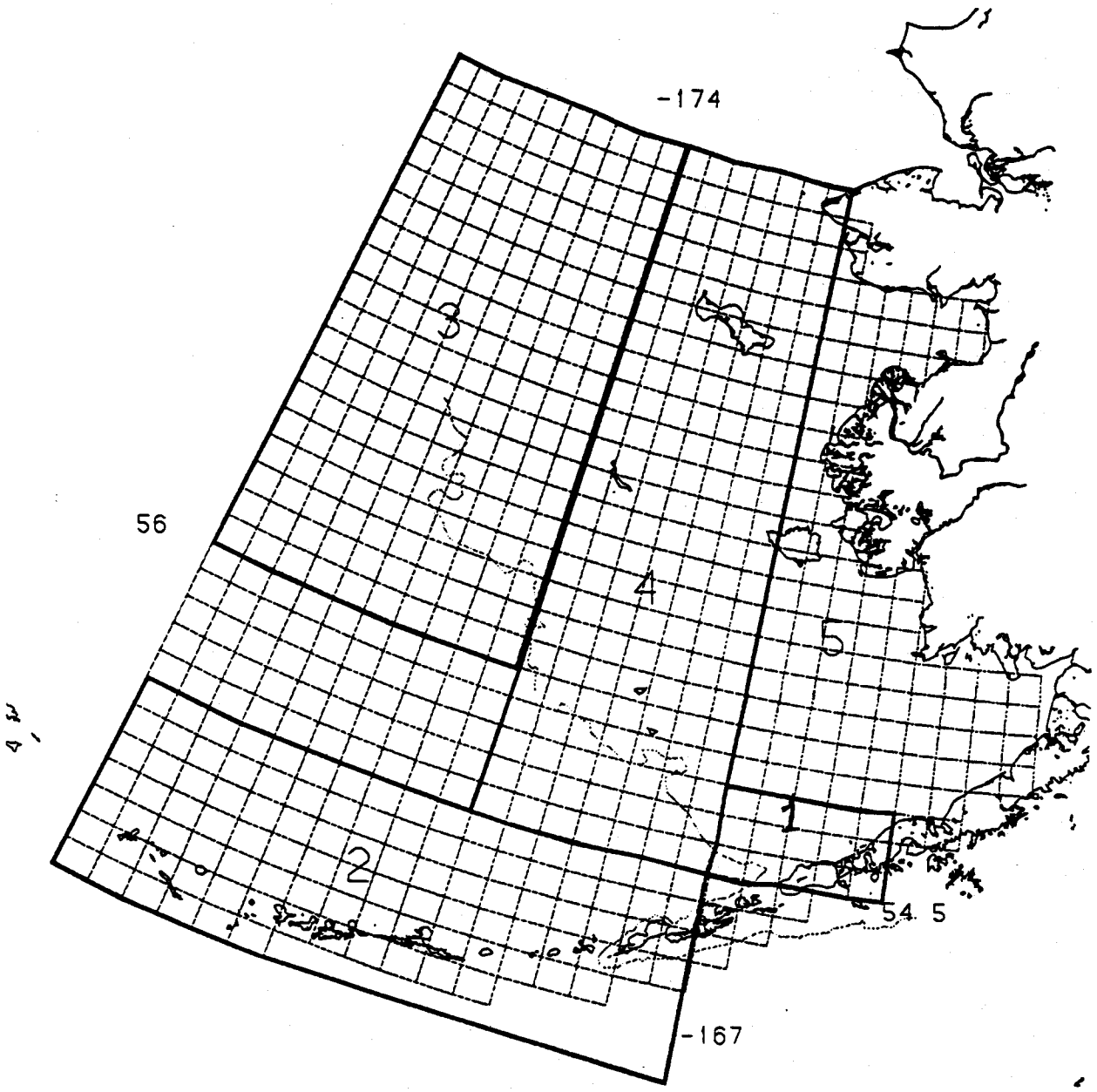


Figure 8. Annual species composition of foreign and Joint Venture trawl fisheries bycatch as published by NMFS. Horizontal axis is the percentage of all salmon which are chinook, and the vertical axis is the percentage of the remaining other salmon which are chum salmon.

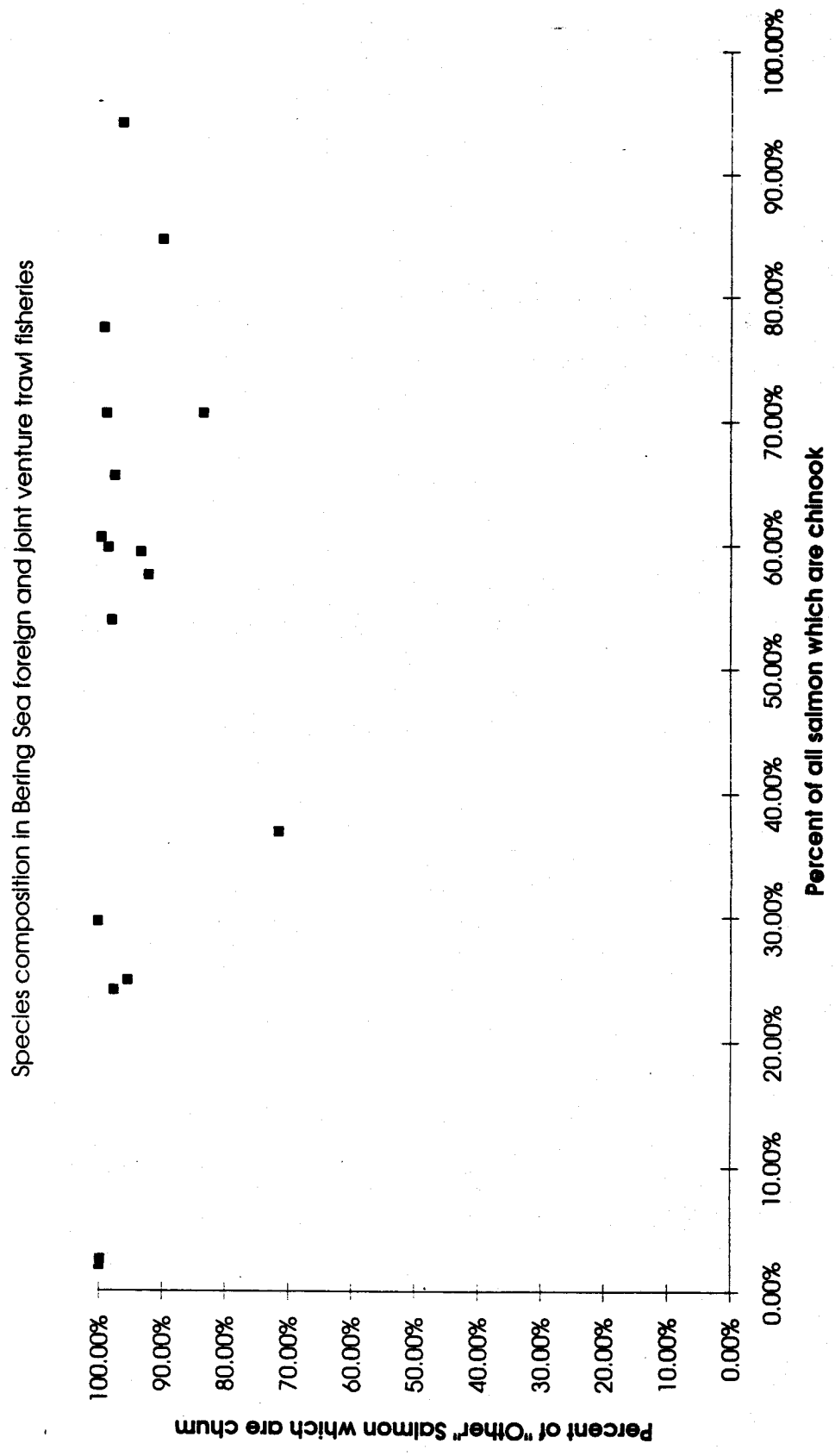


Figure 9. Reproduced from: Meyers et al. 1990, p. 22. Ranges of chum salmon in the North Pacific based on tagging studies. "The reader is cautioned against misinterpretation of the results presented in ..(figures). For all species, the known limits of ocean distribution are wider than the known ocean ranges of Asian and North American stocks as shown by tagging experiments."

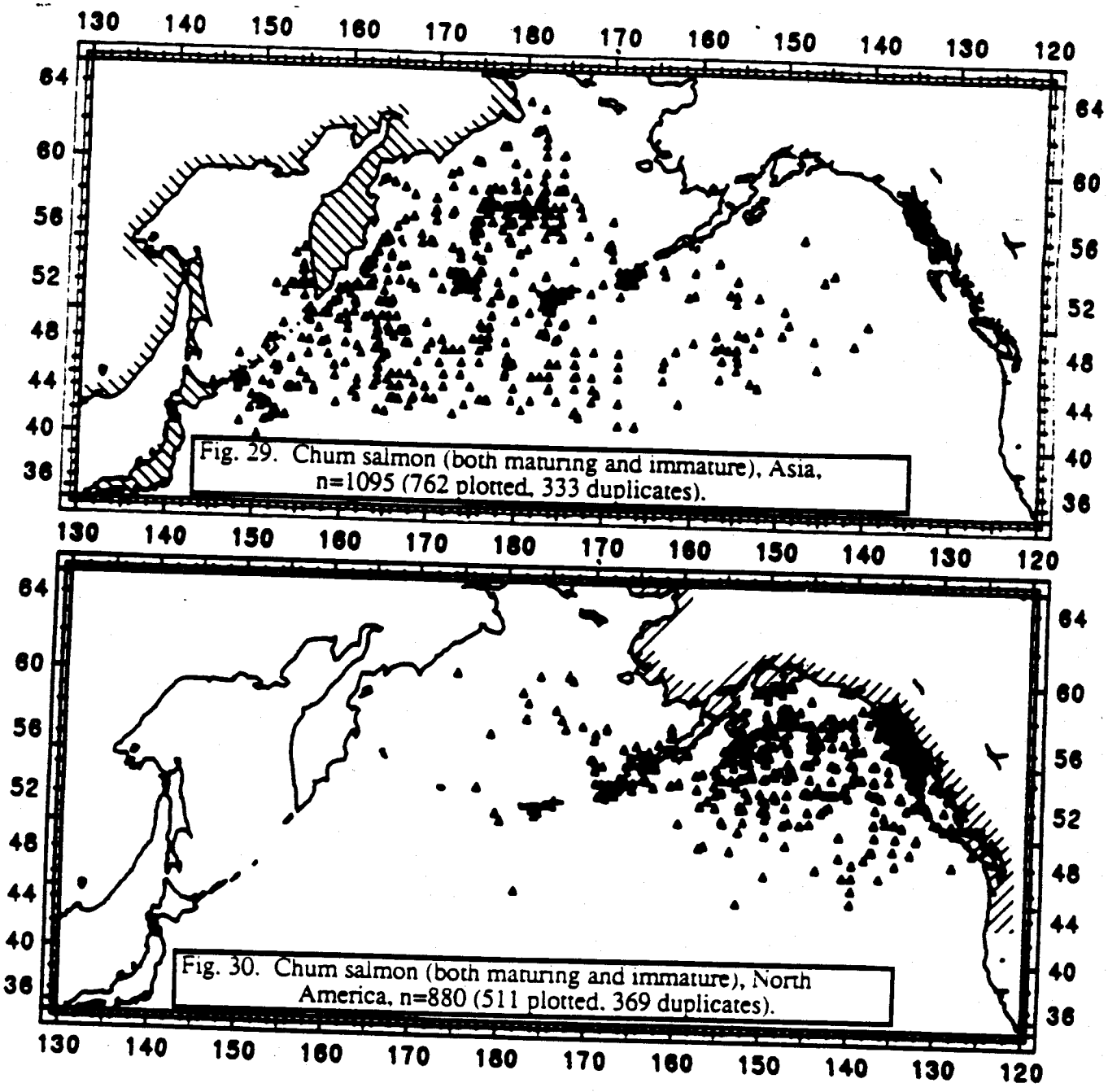


Figure 10. Catch and escapement estimates for chum salmon runs in the North Pacific. Note that Hokkaido and Honshu hatchery returns are not included. (SE.BC&WA = Southeast Alaska, British Columbia and Washington). Data from Rogers 1994.

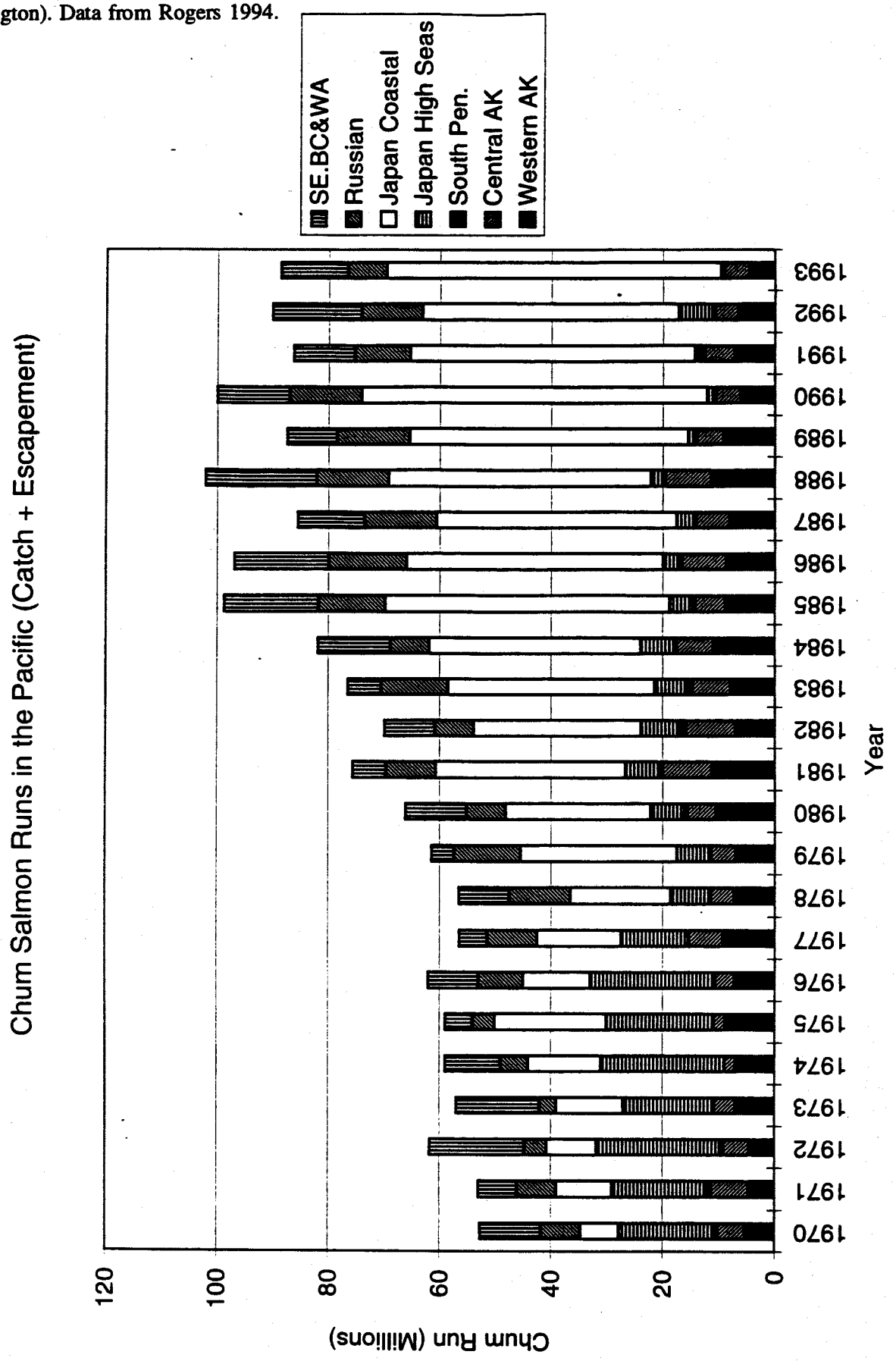


Figure 11. Mean length (cm) at age for chum salmon returns to the Nushagak River in Bristol Bay, AK, and mean length from bycaught male and female chum in the Bering Sea (domestic fisheries from 1990).

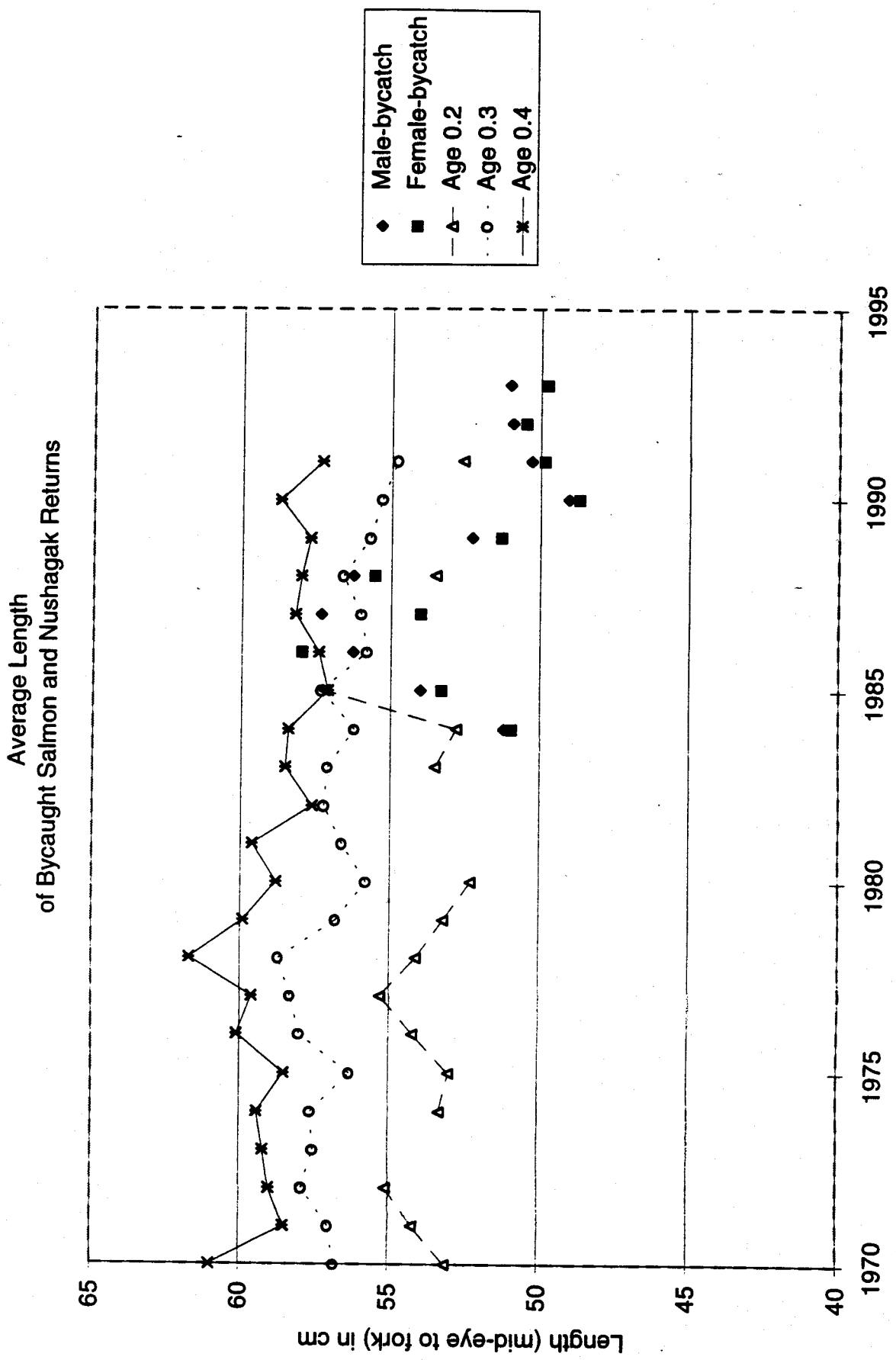
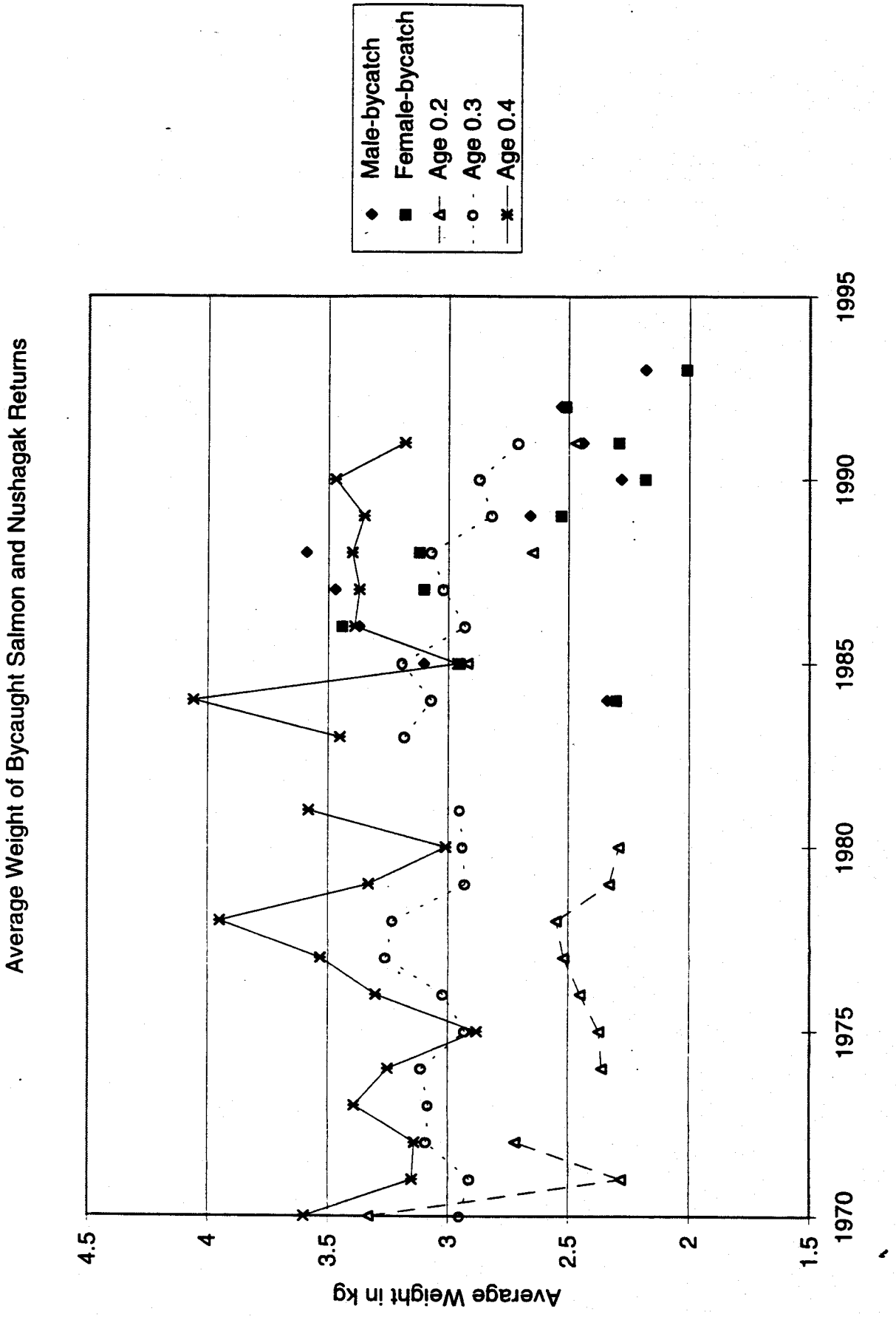


Figure 12. Mean weight (kg) at age for chum salmon returns to the Nushagak River in Bristol Bay, AK, and mean weight from bycaught male and female chum in the Bering Sea (domestic fisheries from 1990).



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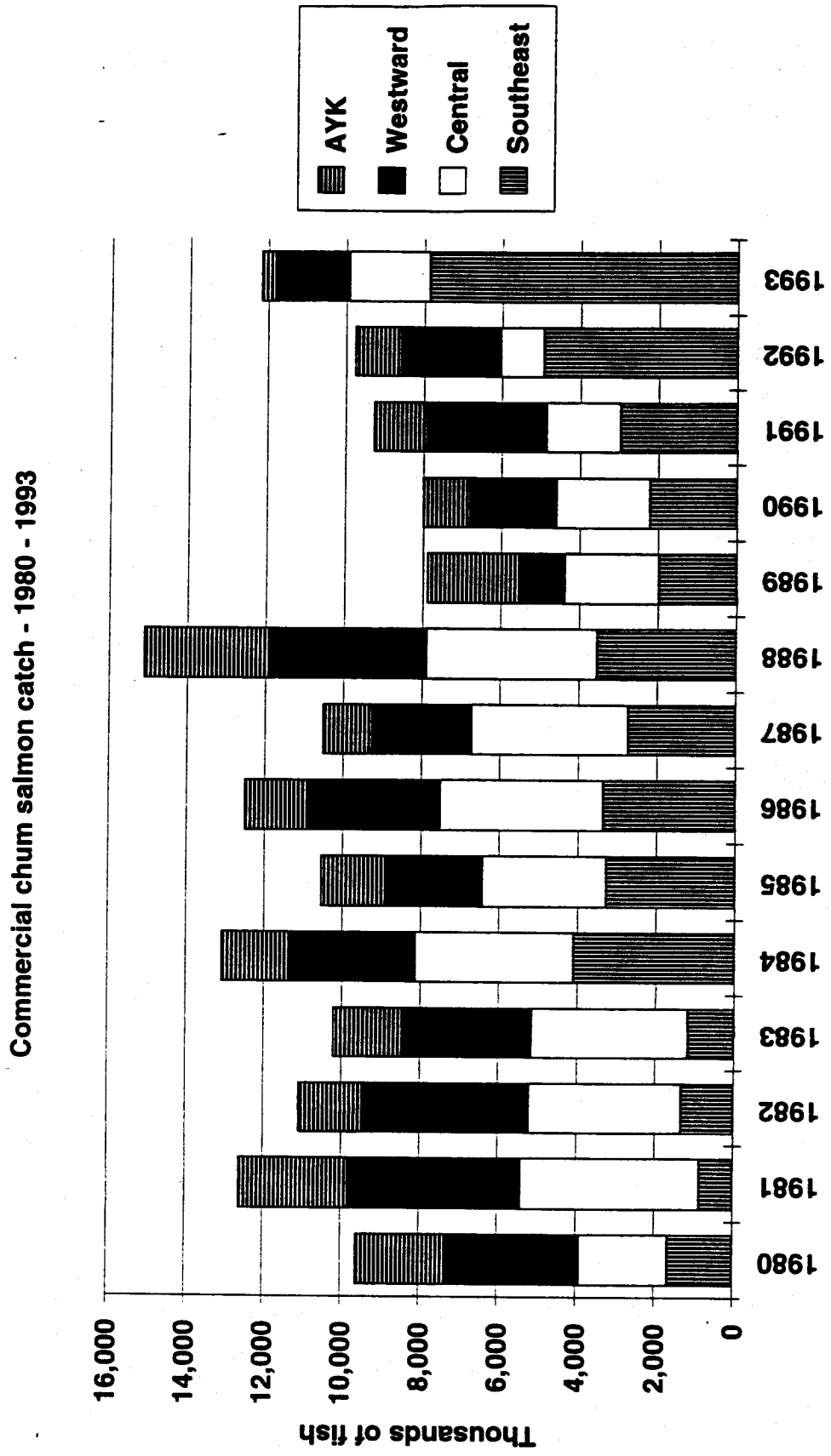
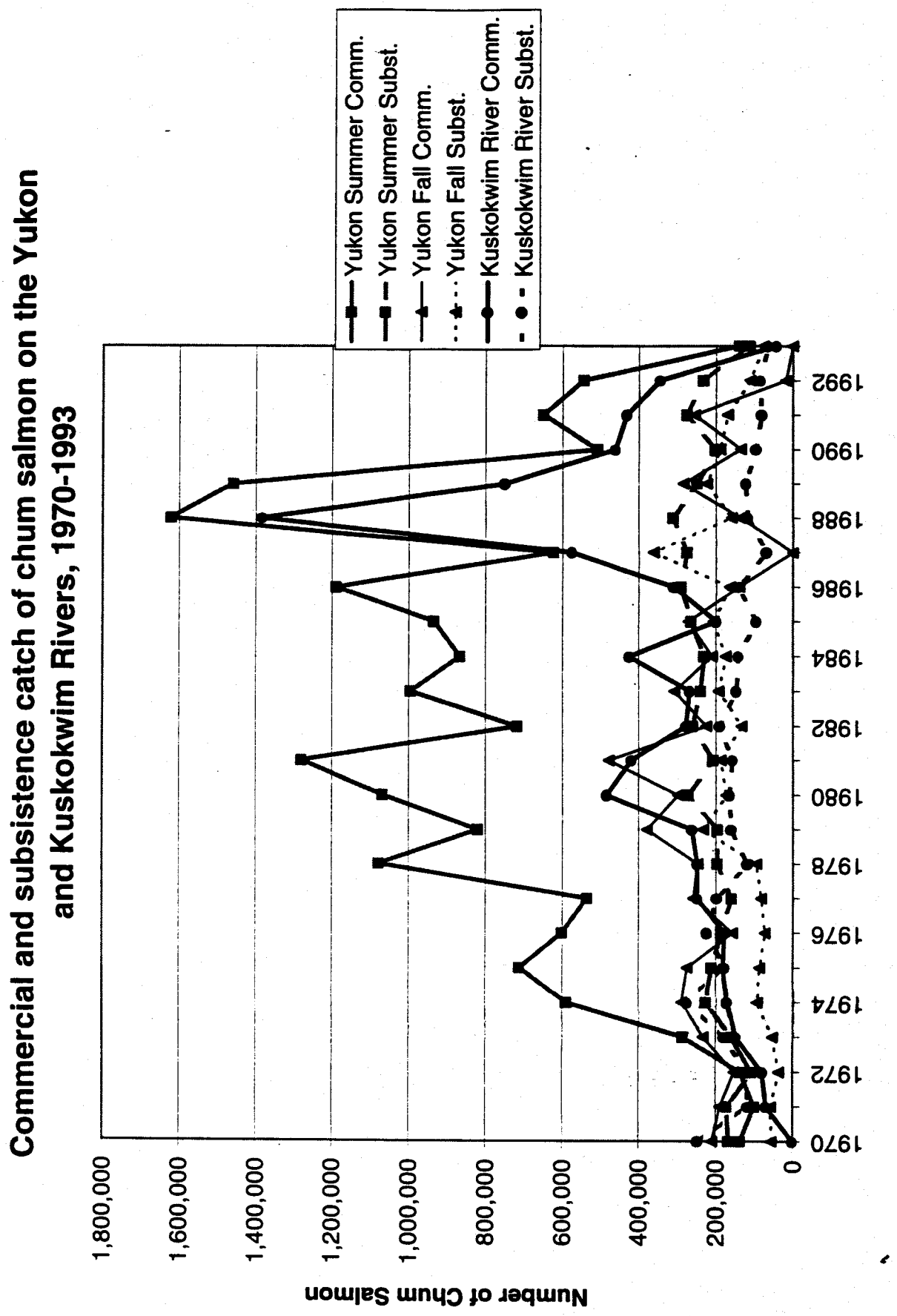


Figure 14. Estimated commercial and subsistence catch of summer and fall run chum salmon on the Yukon River, and chum salmon on the Kuskokwim River (not entire Kuskokwim Area).



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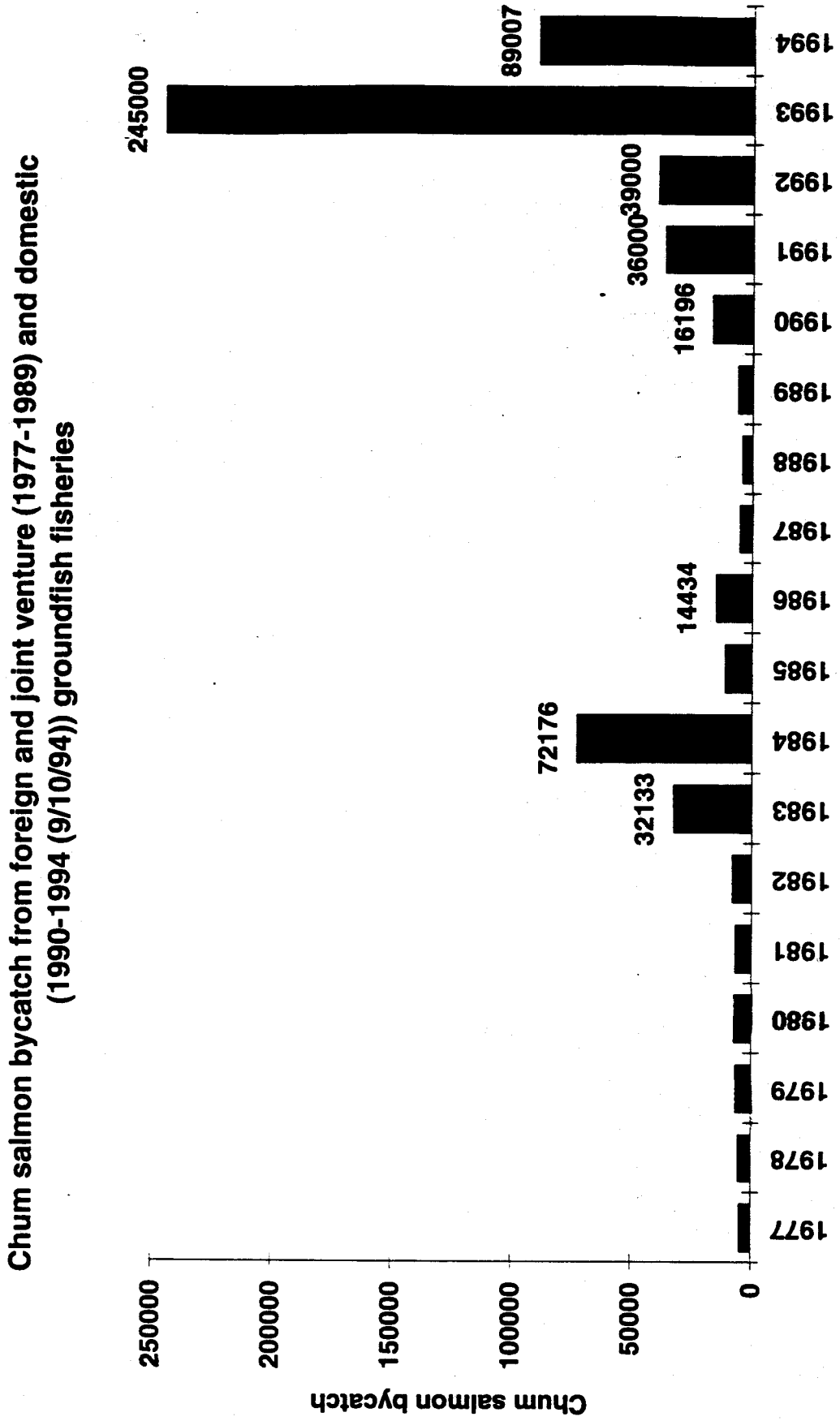
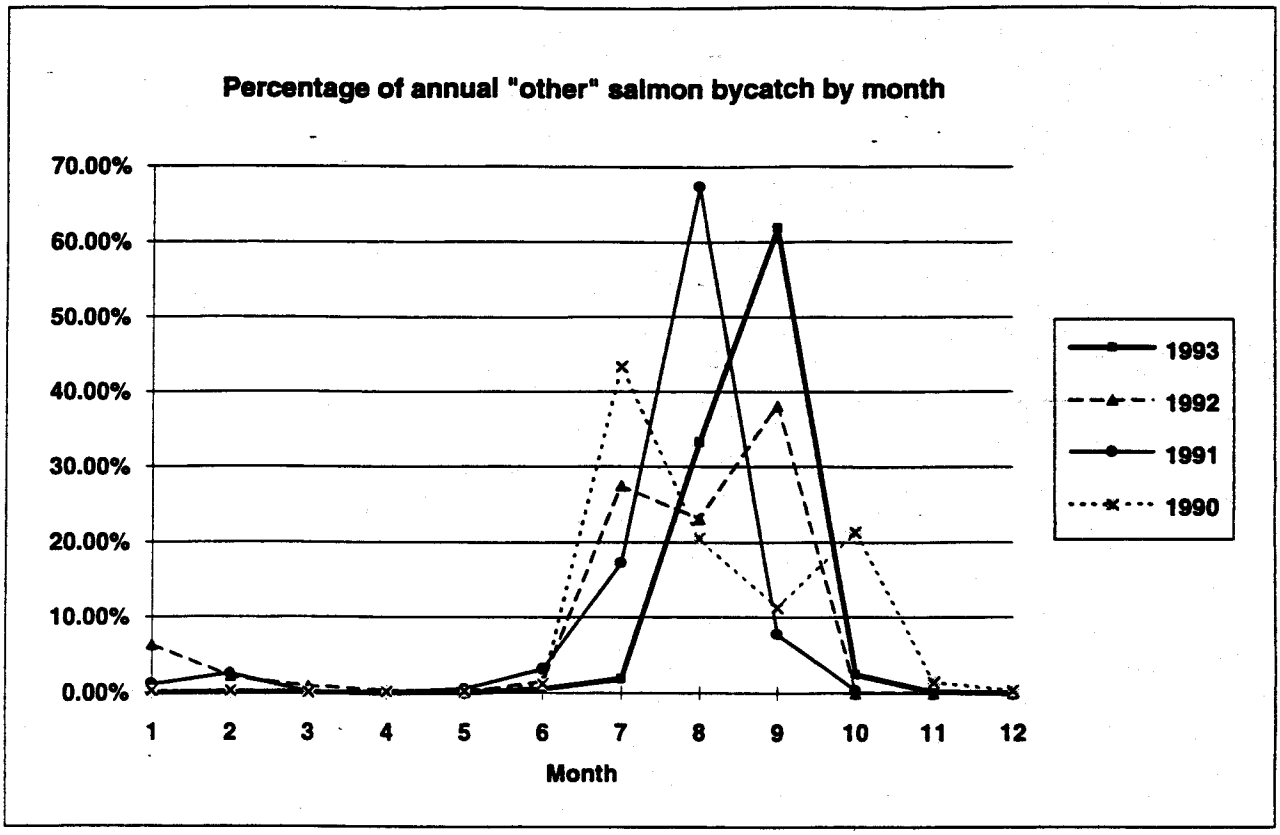
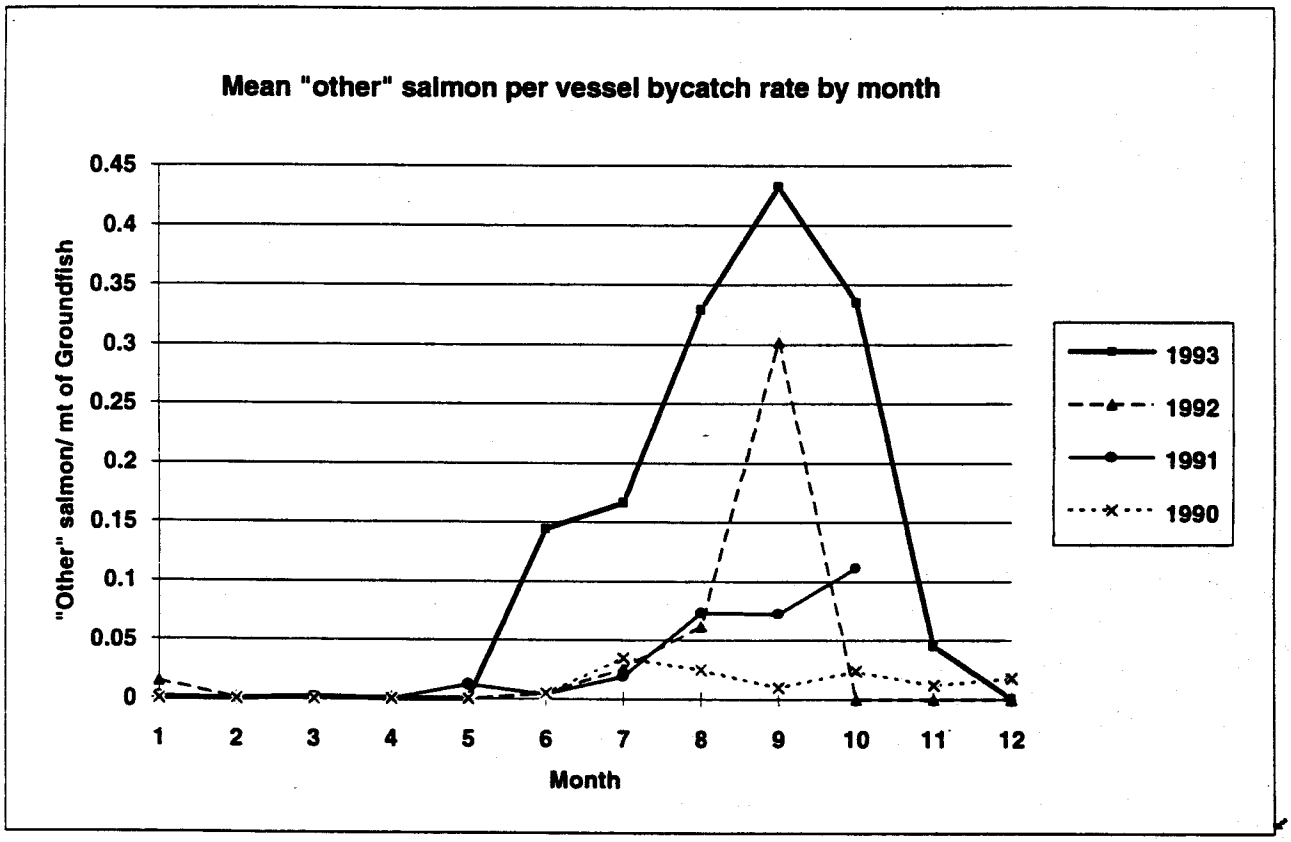


Figure 16. Top: Percentage of annual other salmon bycatch by month from observed hauls only 1990-1993. Bottom: Mean other salmon bycatch rate as per vessel bycatch per metric ton of groundfish catch.





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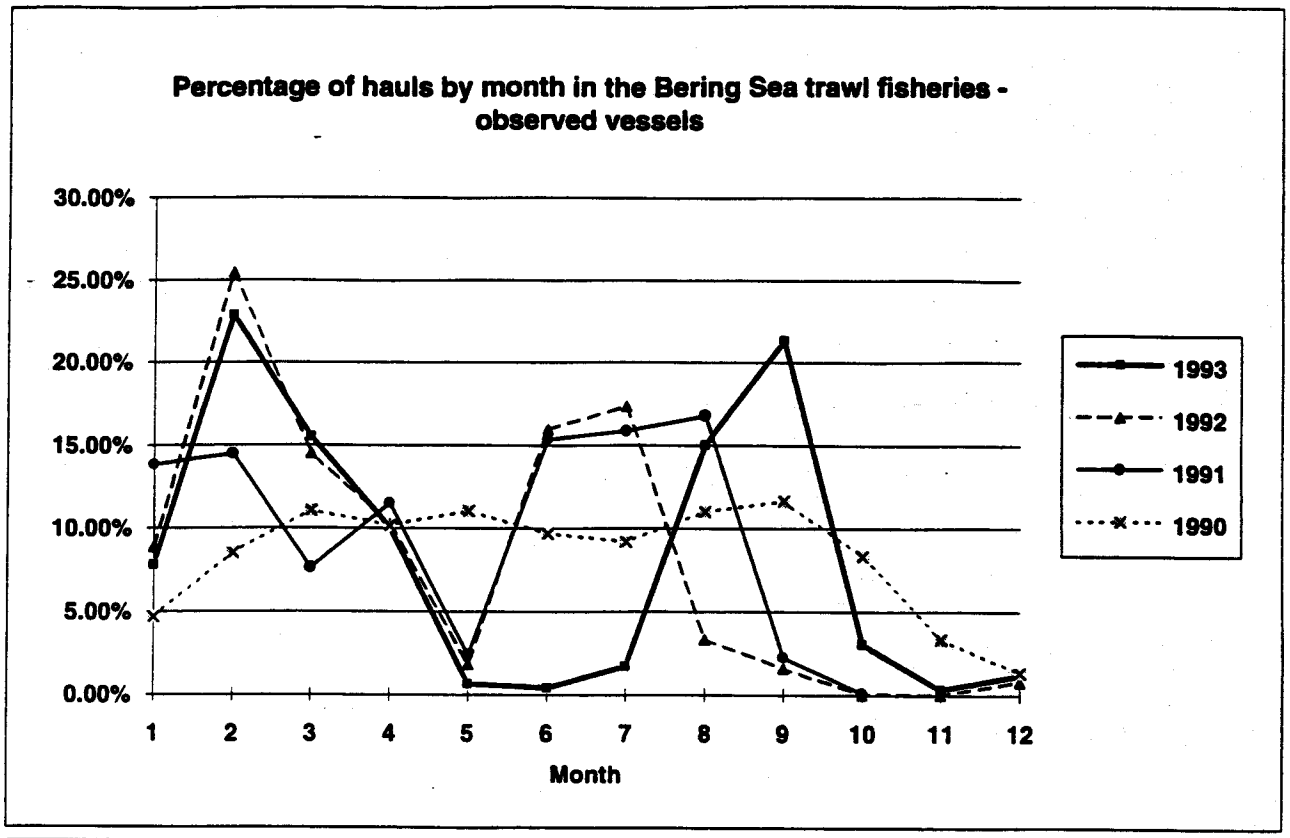


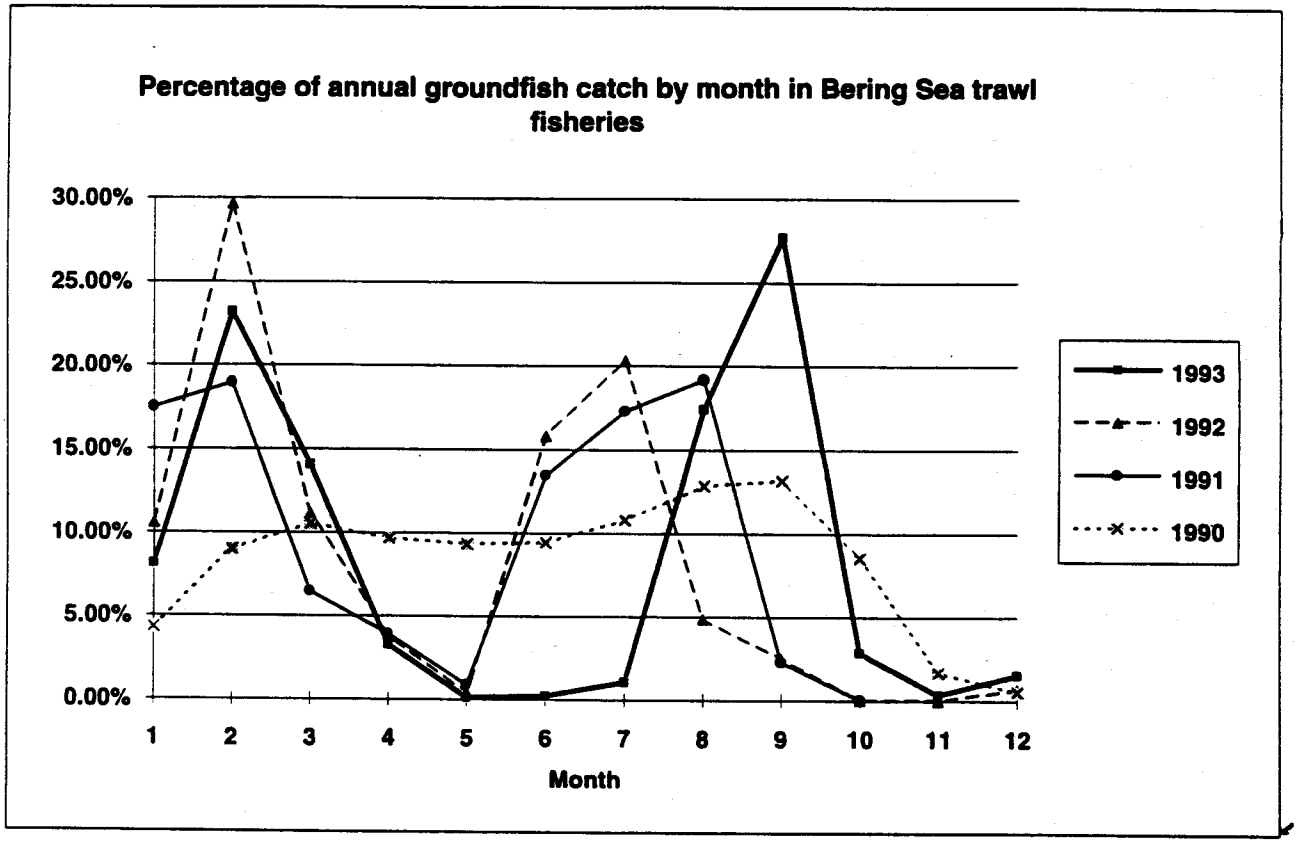
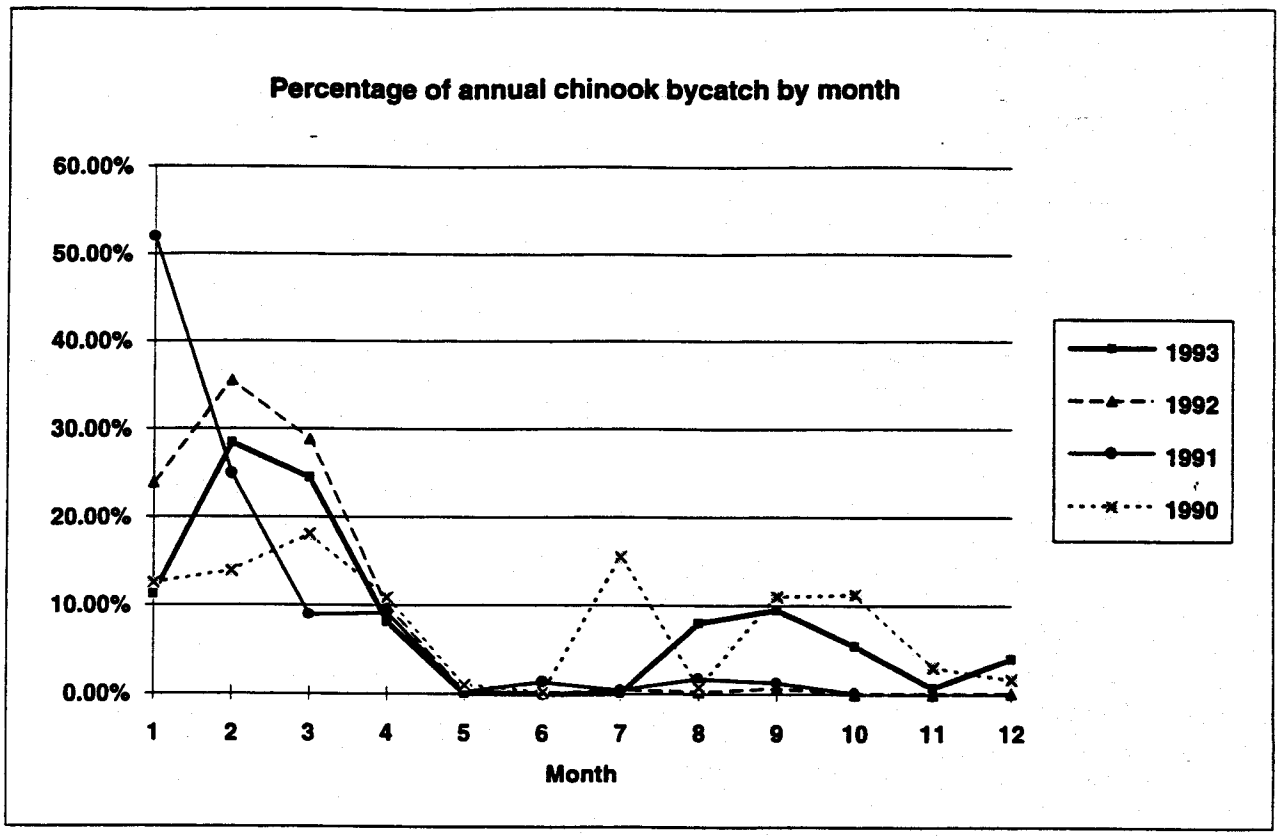


Figure 18. Top: Percentage of total annual chinook bycatch by month from observed vessels only 1990-1993. Bottom: Mean chinook salmon bycatch rate as per-vessel bycatch per metric ton of groundfish catch.



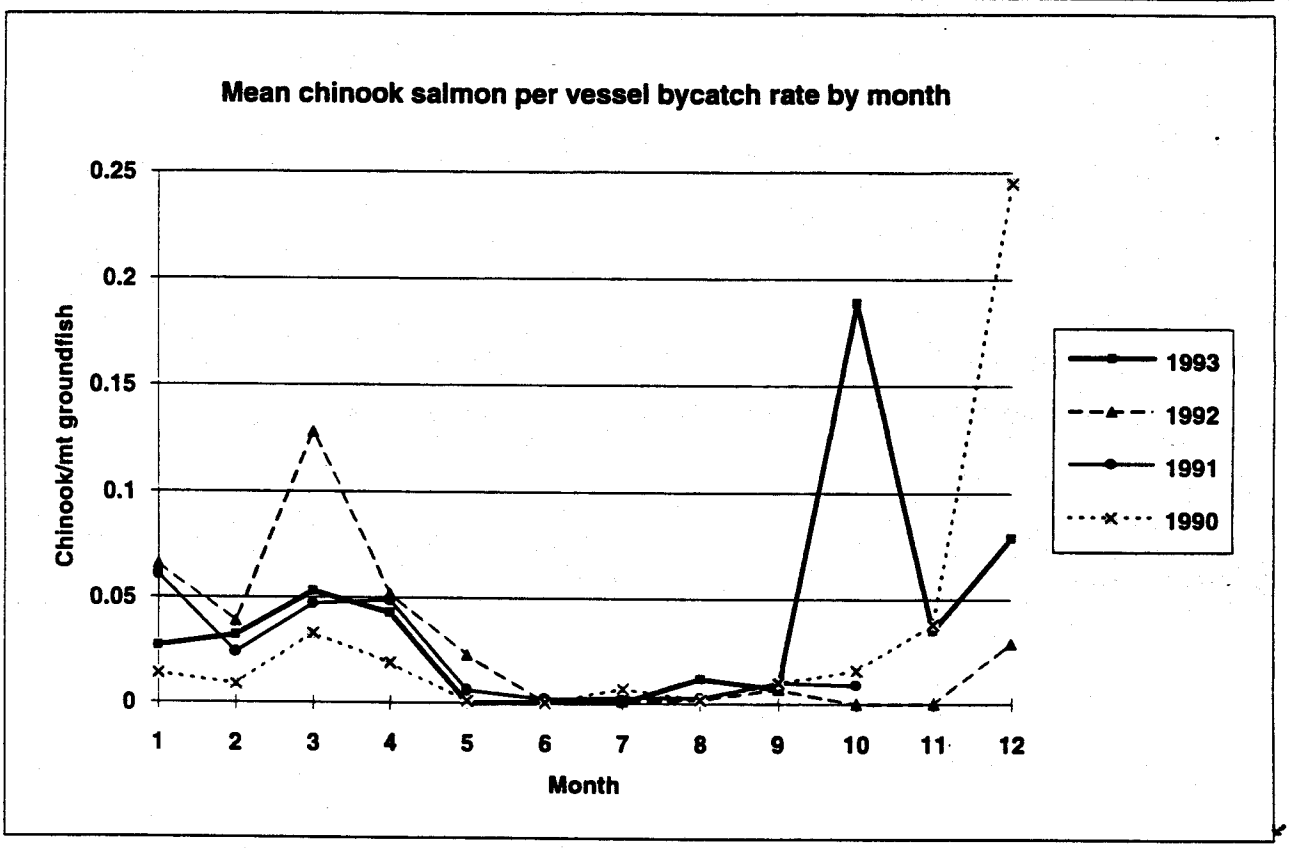
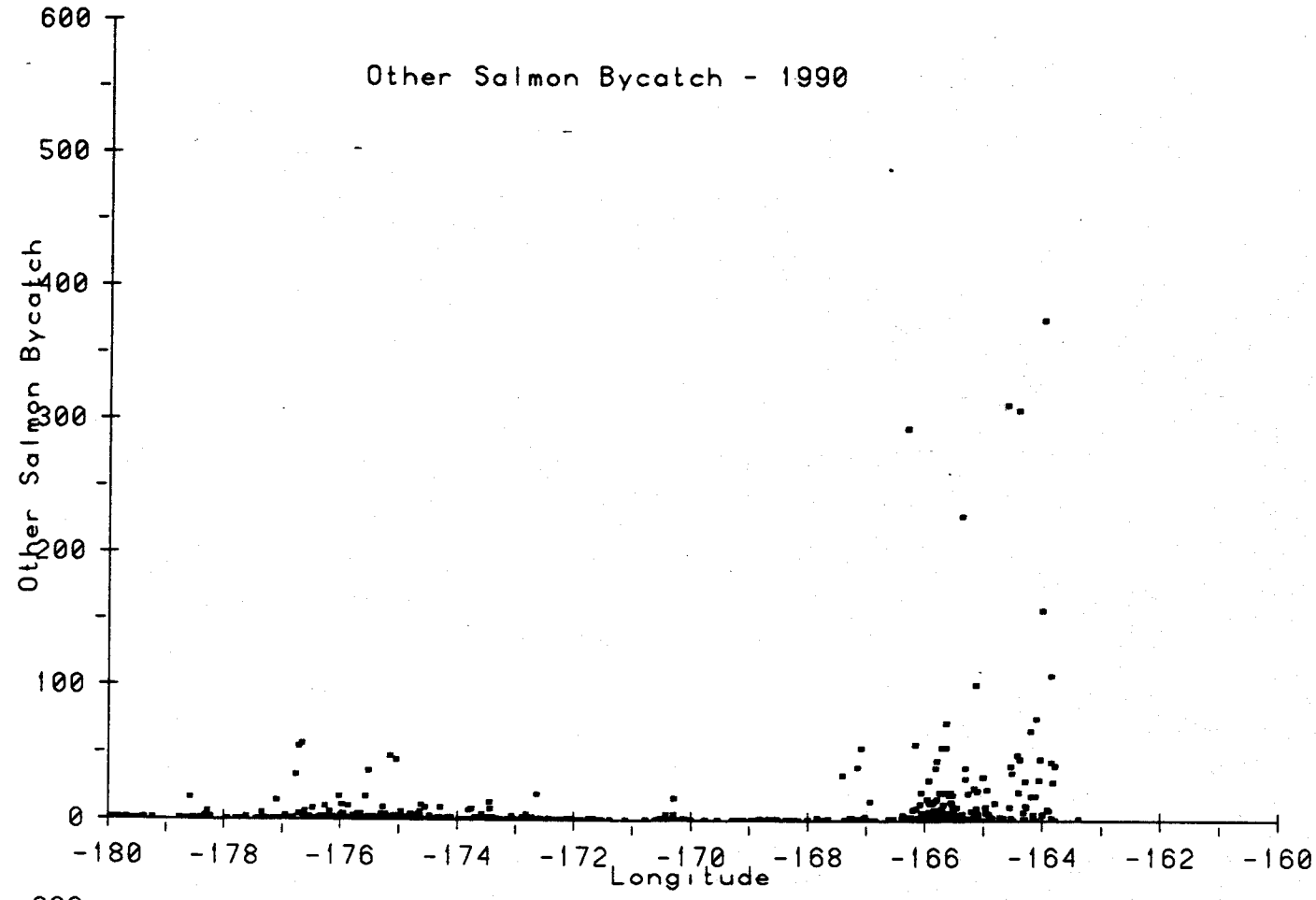


Figure 19. Bycatch of other salmon from observed hauls in 1990. Horizontal axes are the longitude and latitude locations of the observed hauls.



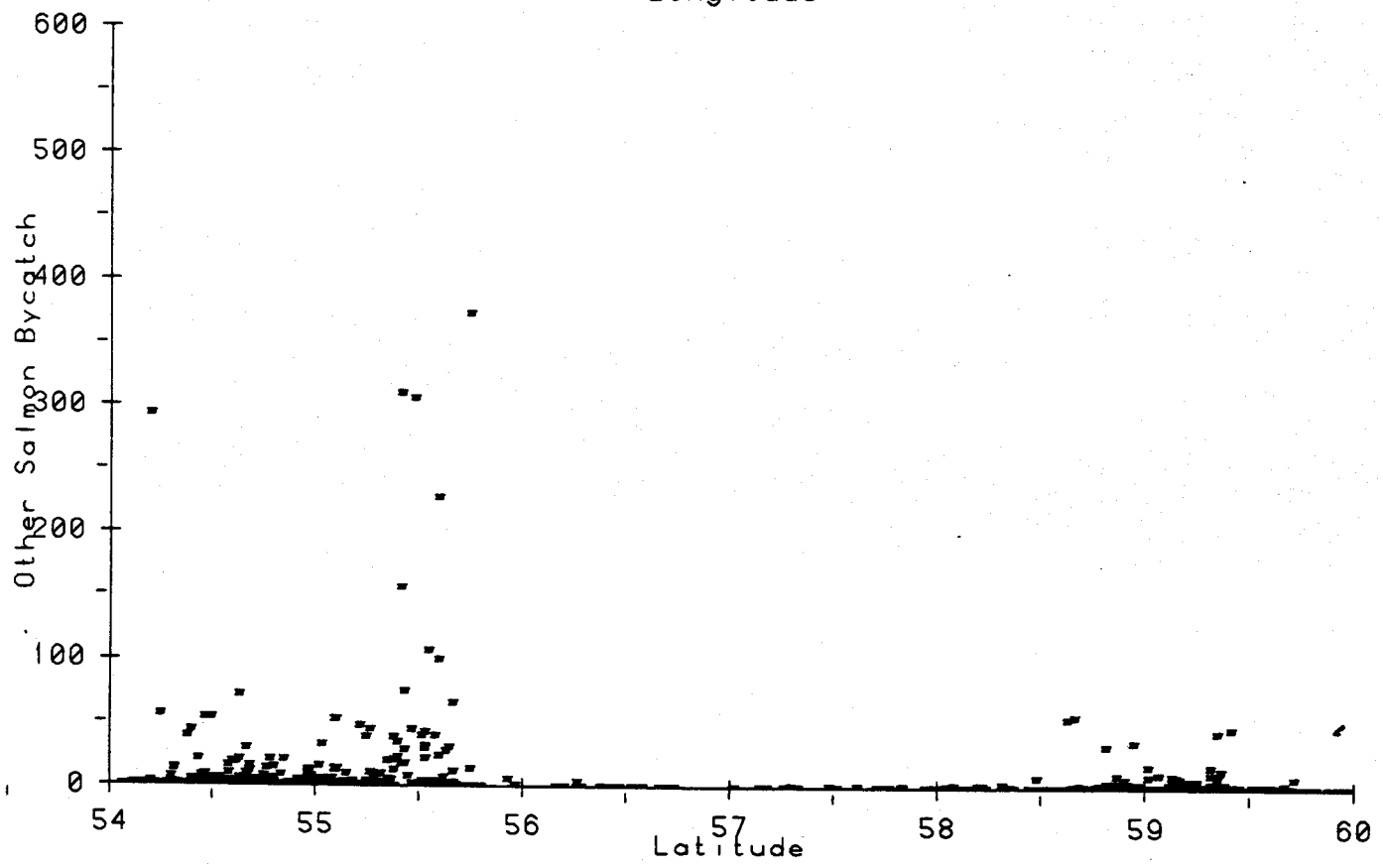
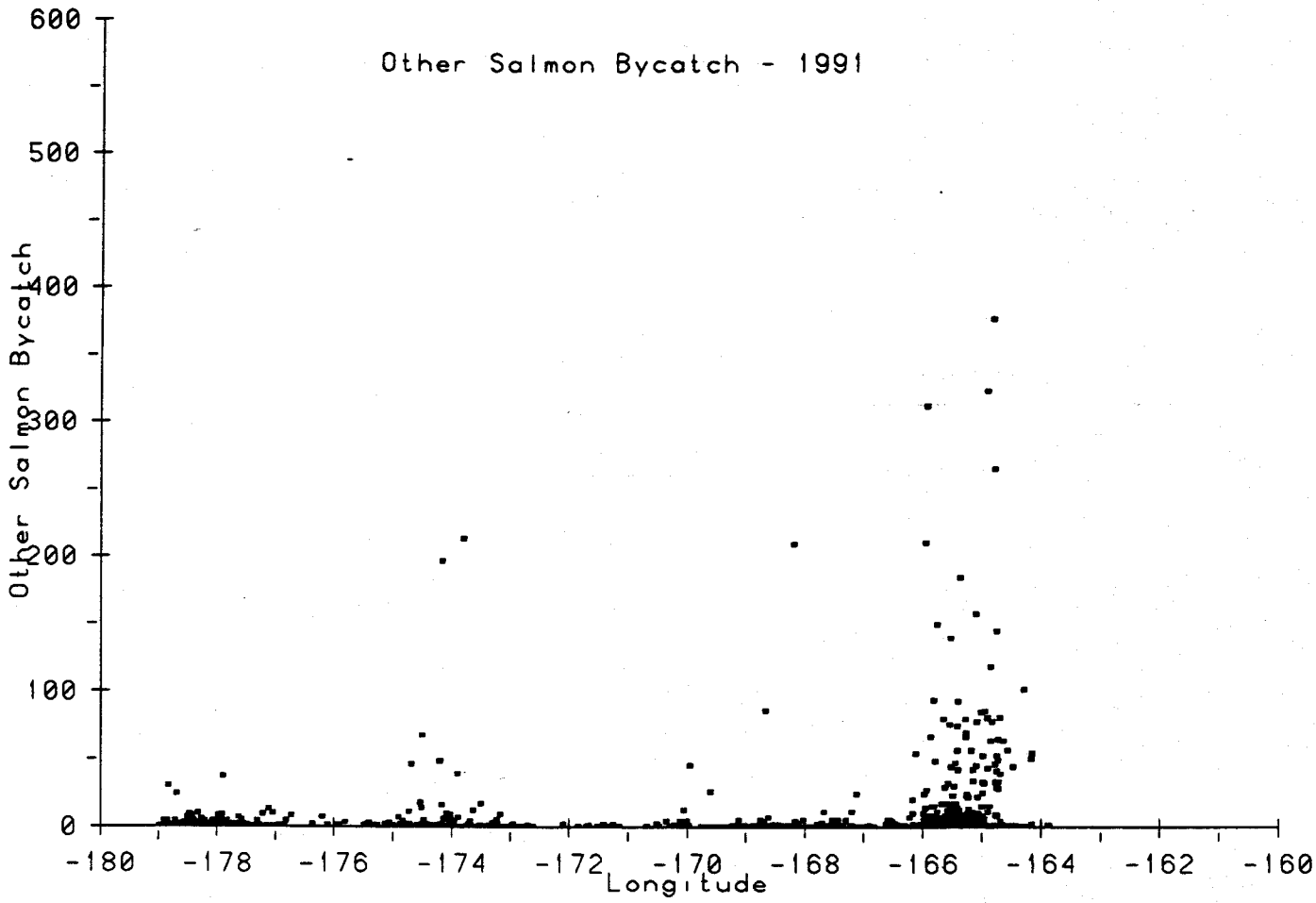


Figure 20. Bycatch of other salmon from observed hauls in 1991. Horizontal axes are the longitude and latitude locations of the observed hauls.



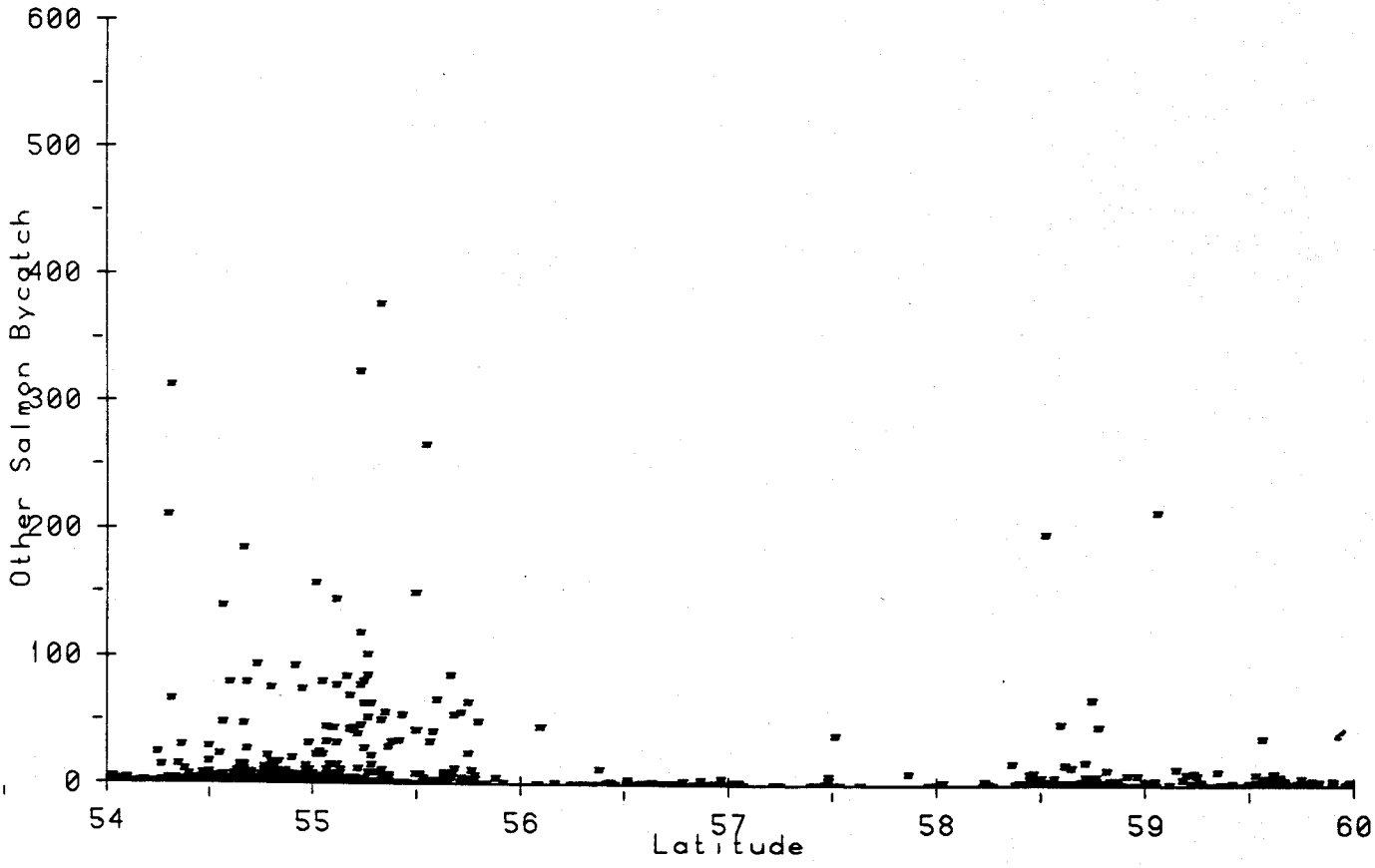
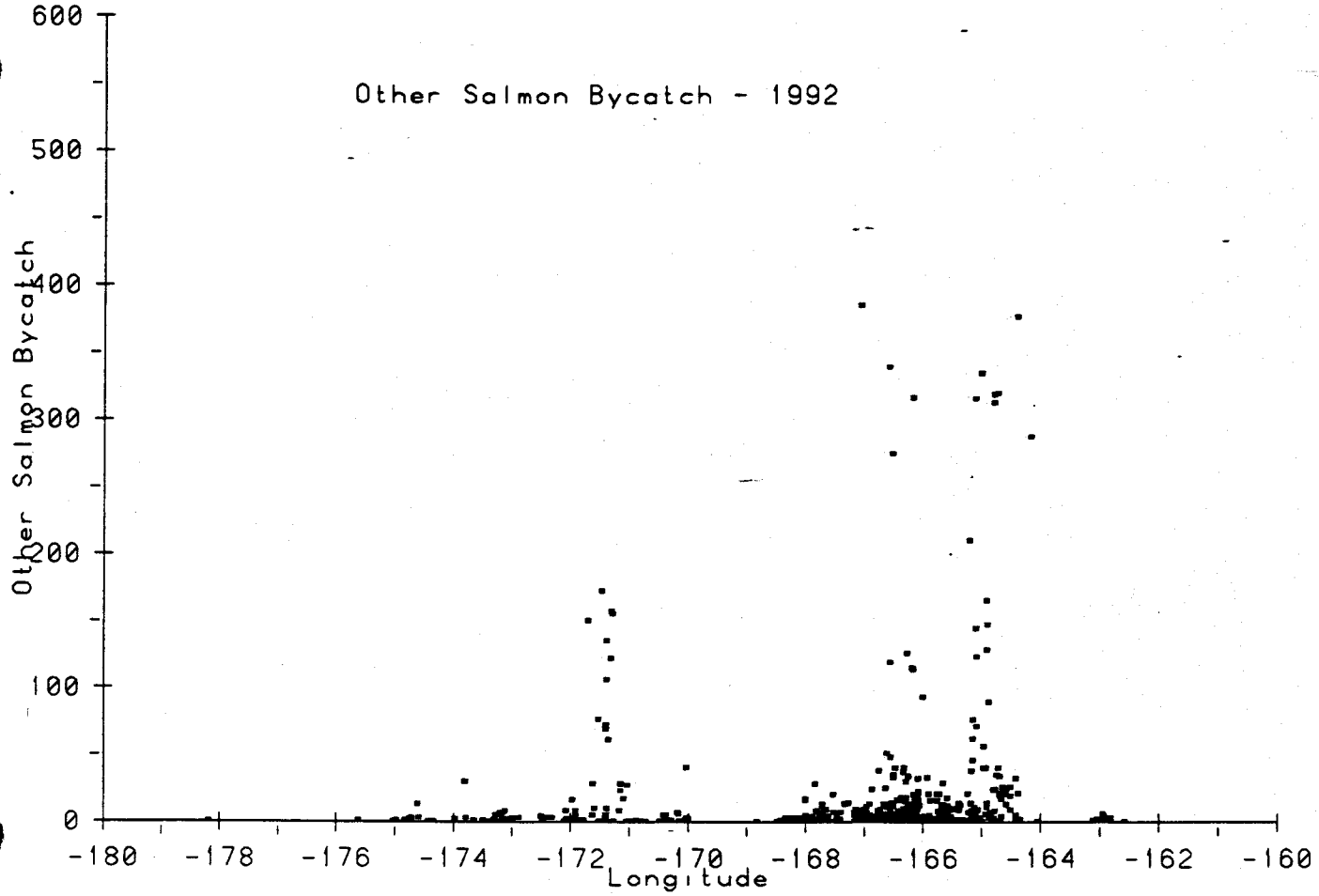


Figure 21. Bycatch of other salmon from observed hauls in 1992. Horizontal axes are the longitude and latitude locations of the observed hauls.



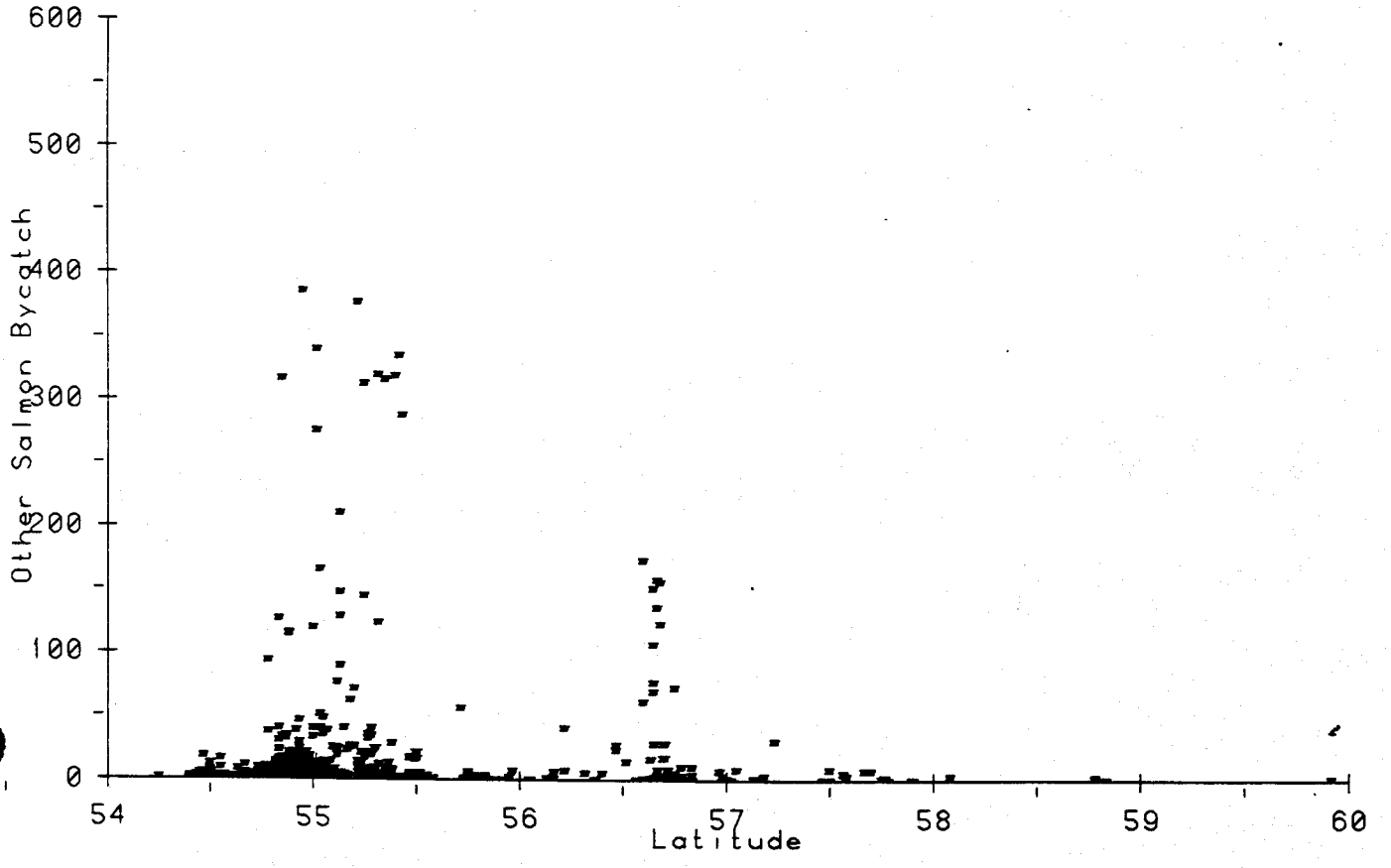


Figure 22. Bycatch of other salmon from observed hauls in 1993. Horizontal axes are the longitude and latitude locations of the observed hauls.

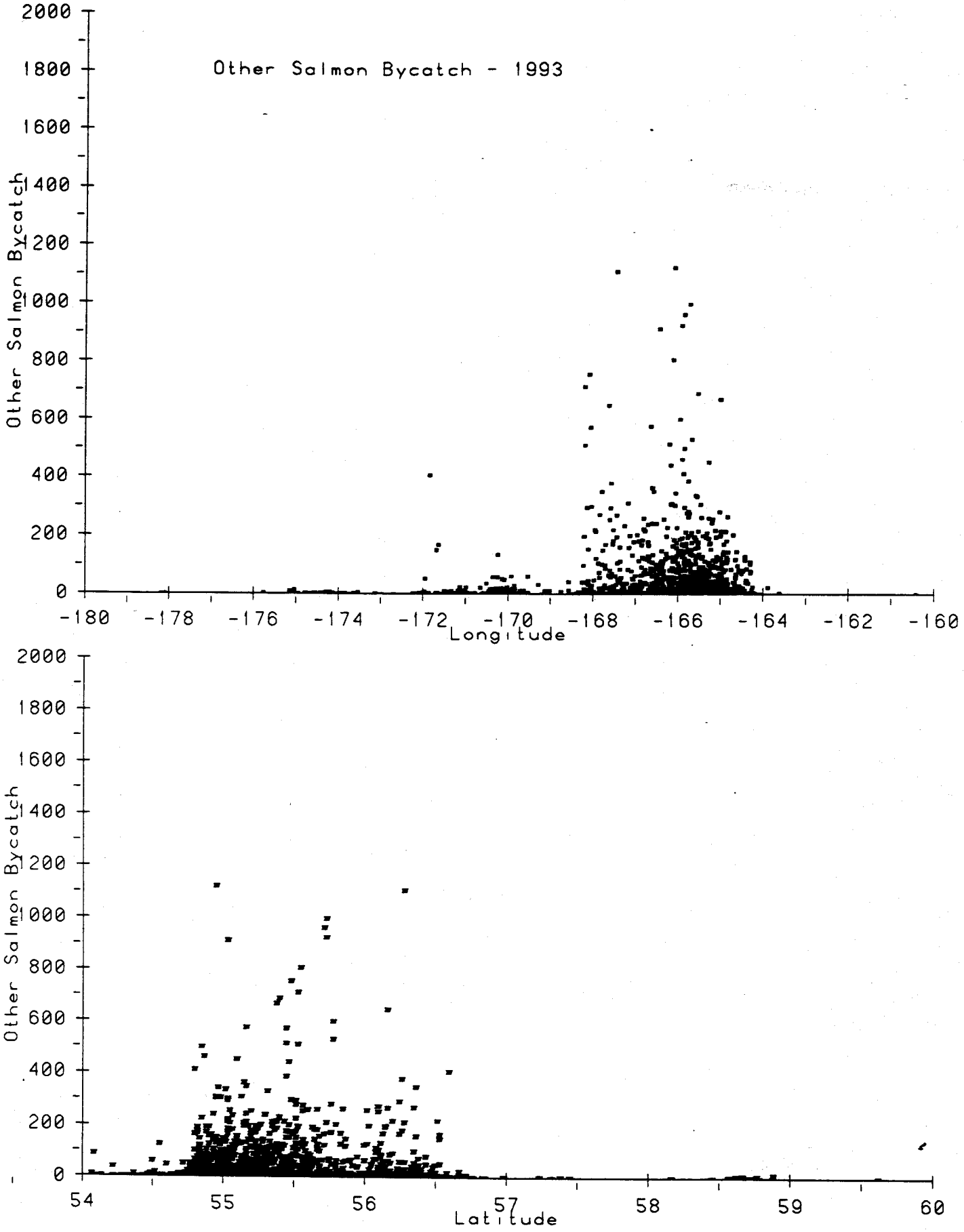
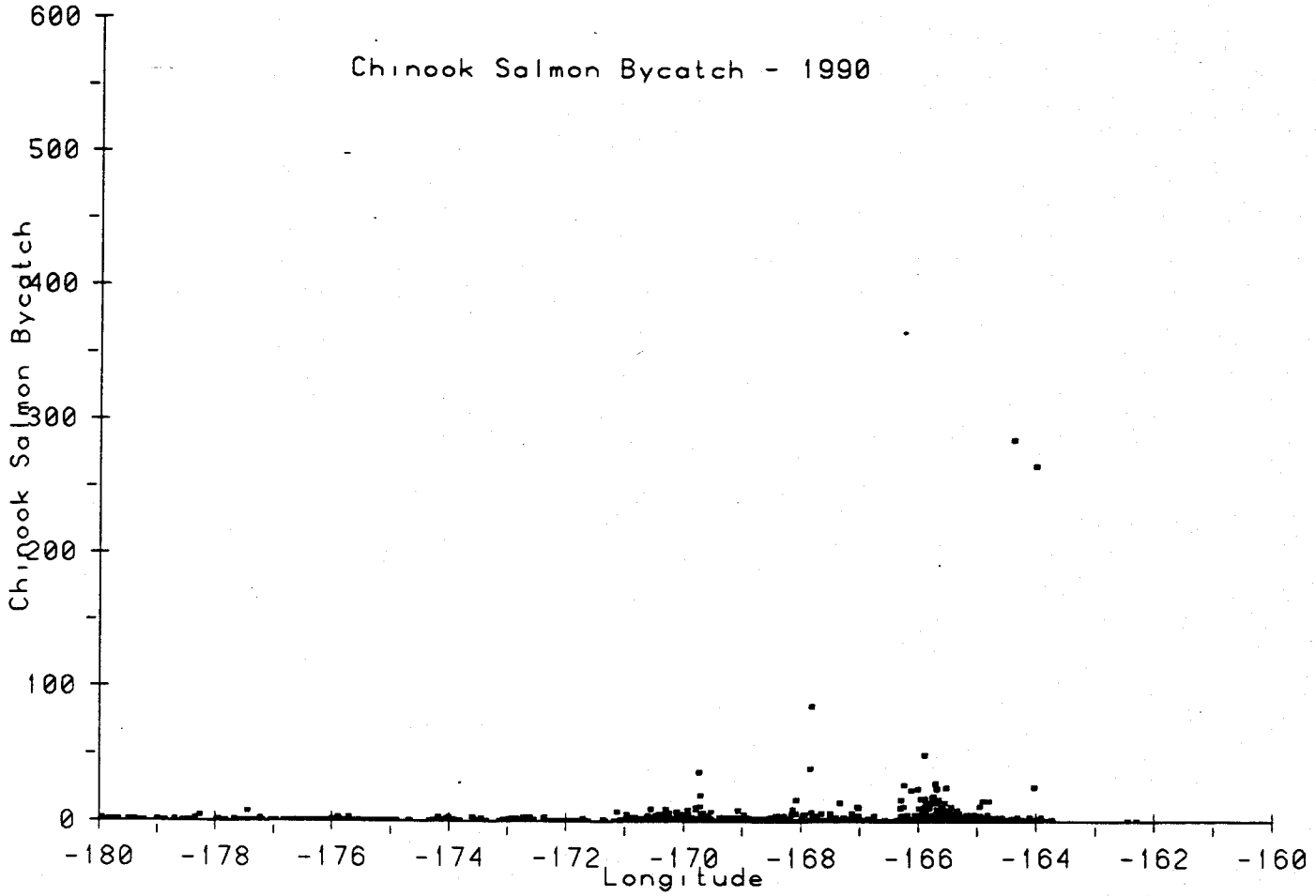


Figure 23. Bycatch of chinook salmon from observed hauls in 1990. Horizontal axes are the longitude and latitude locations of the observed hauls.



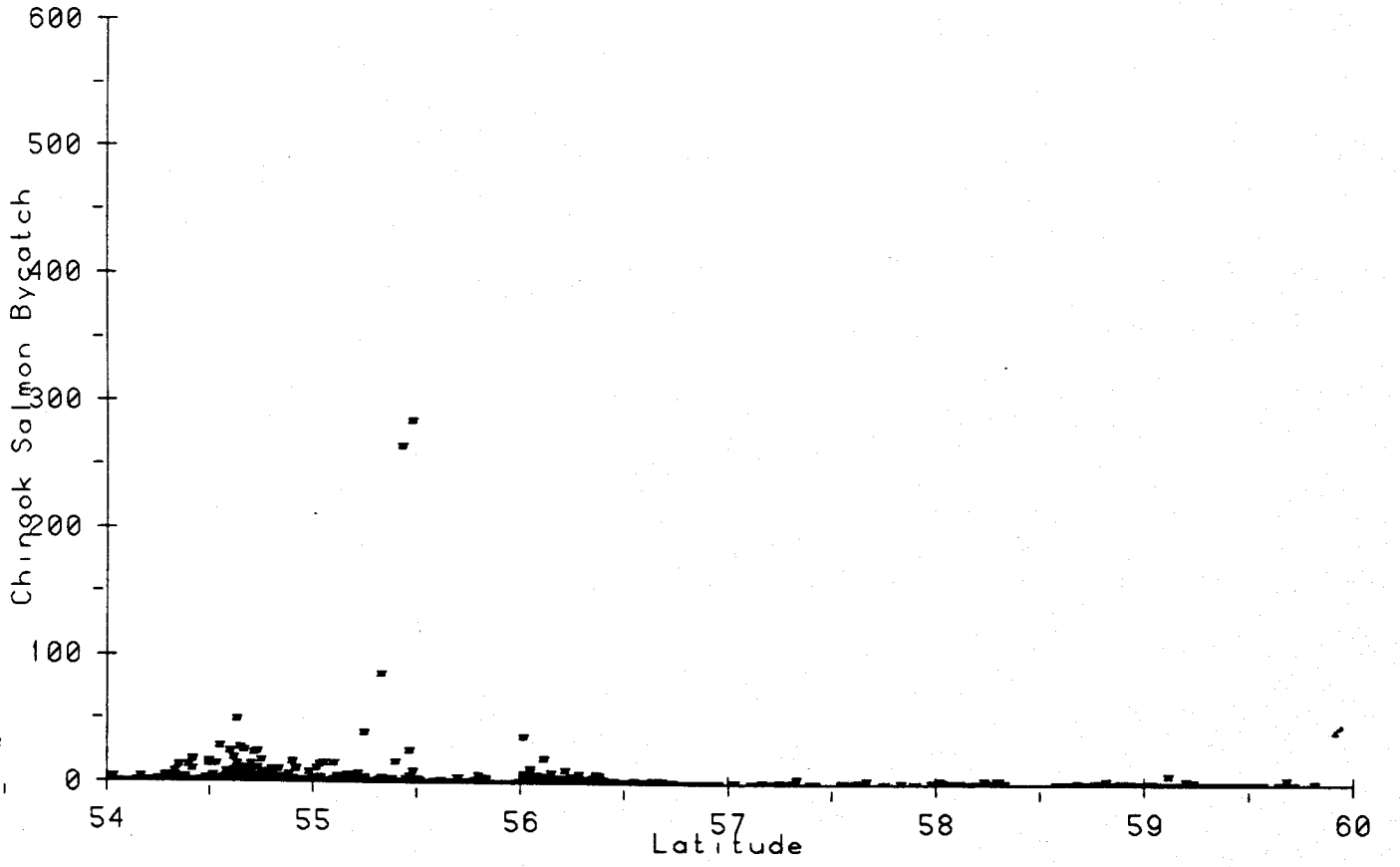
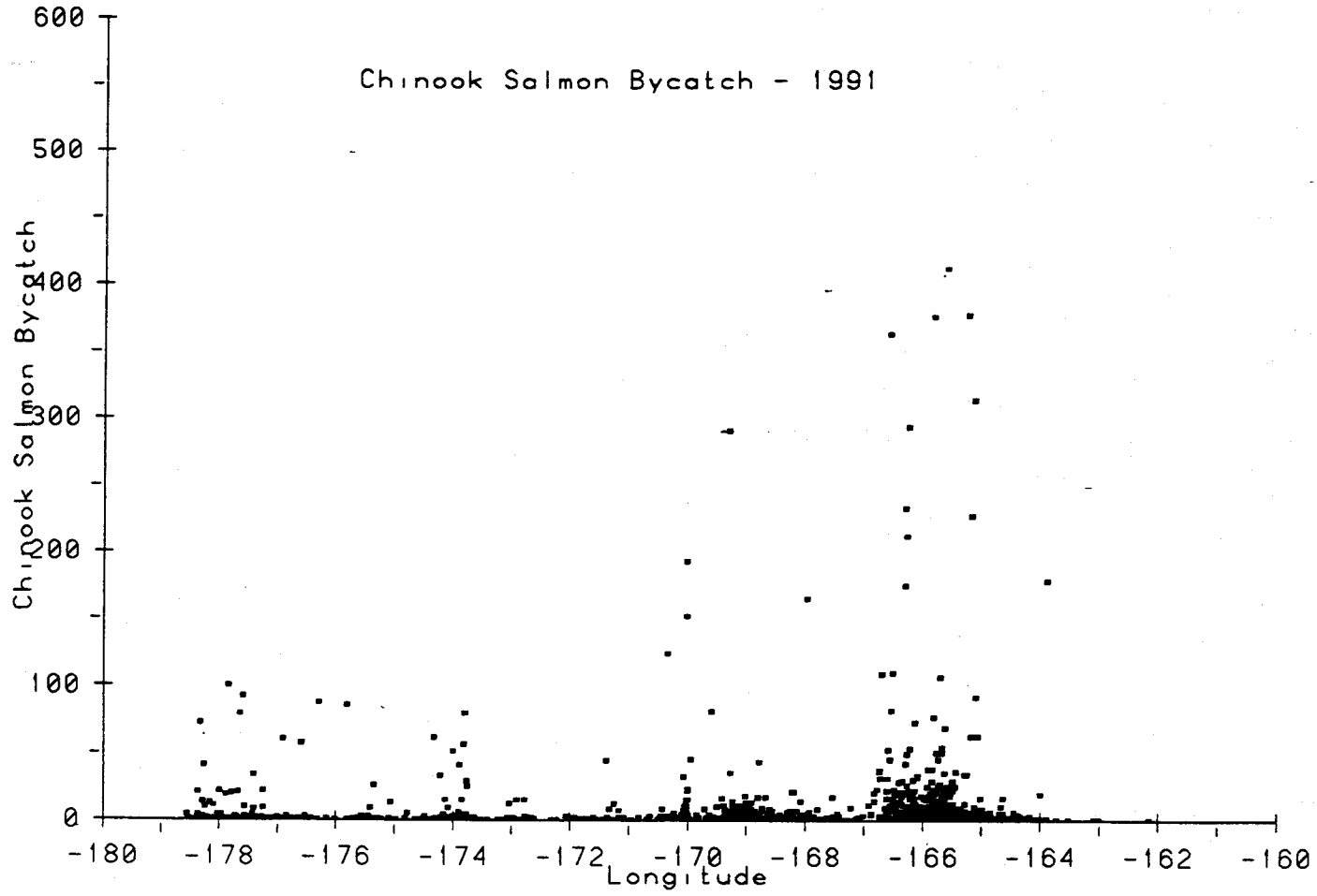


Figure 24. Bycatch of chinook salmon from observed hauls in 1991. Horizontal axes are the longitude and latitude locations of the observed hauls.



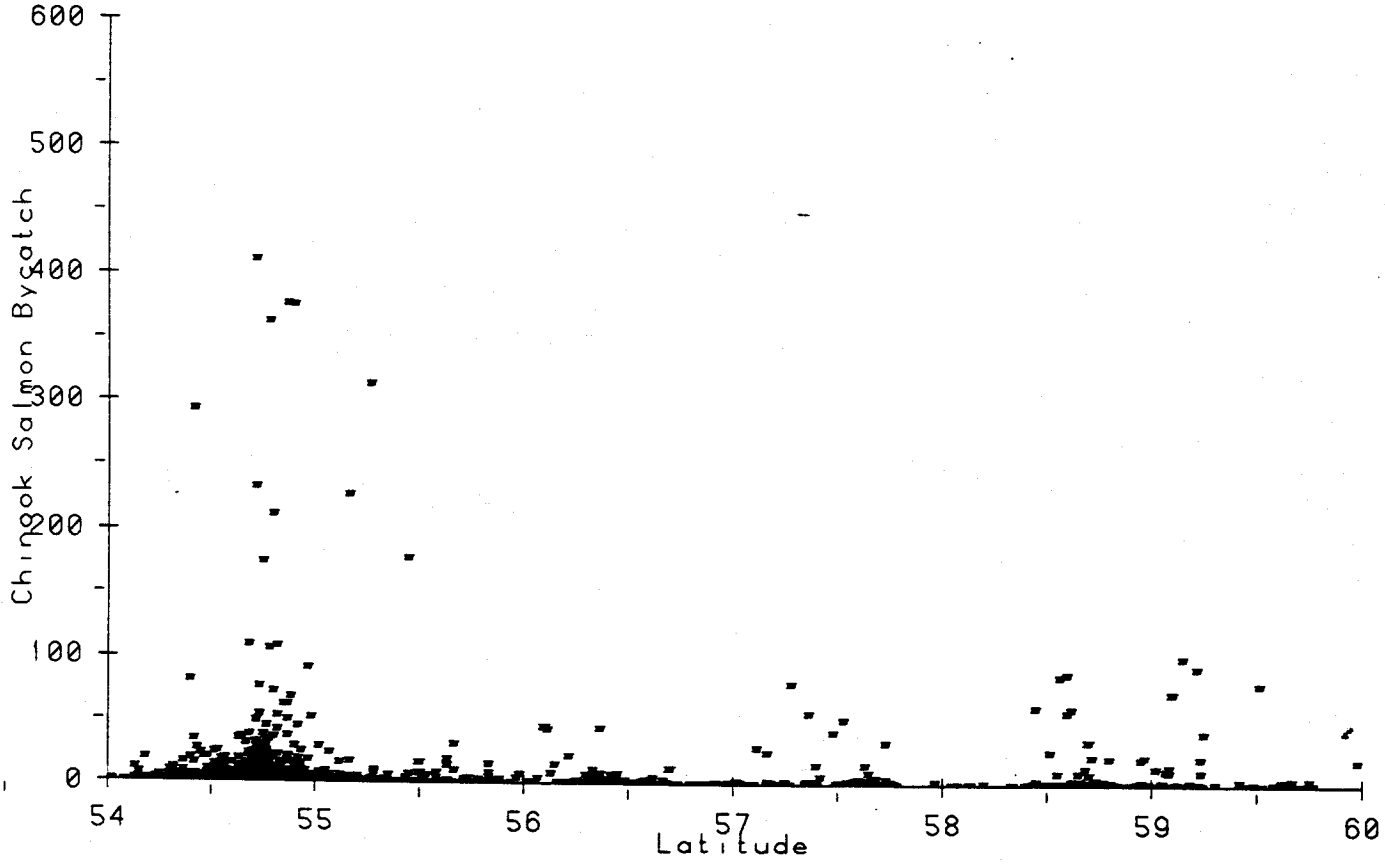
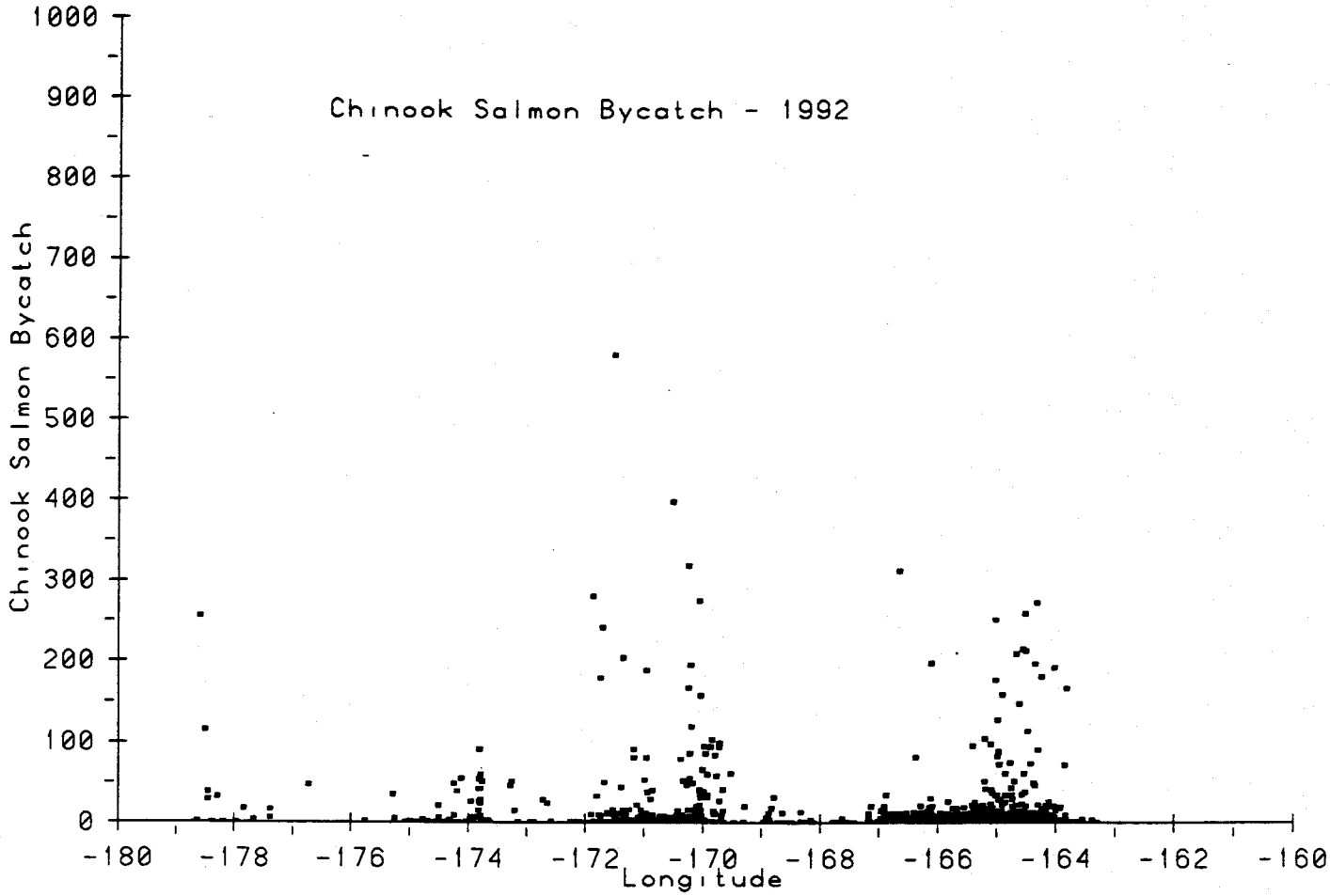


Figure 25. Bycatch of chinook salmon from observed hauls in 1992. Horizontal axes are the longitude and latitude locations of the observed hauls.



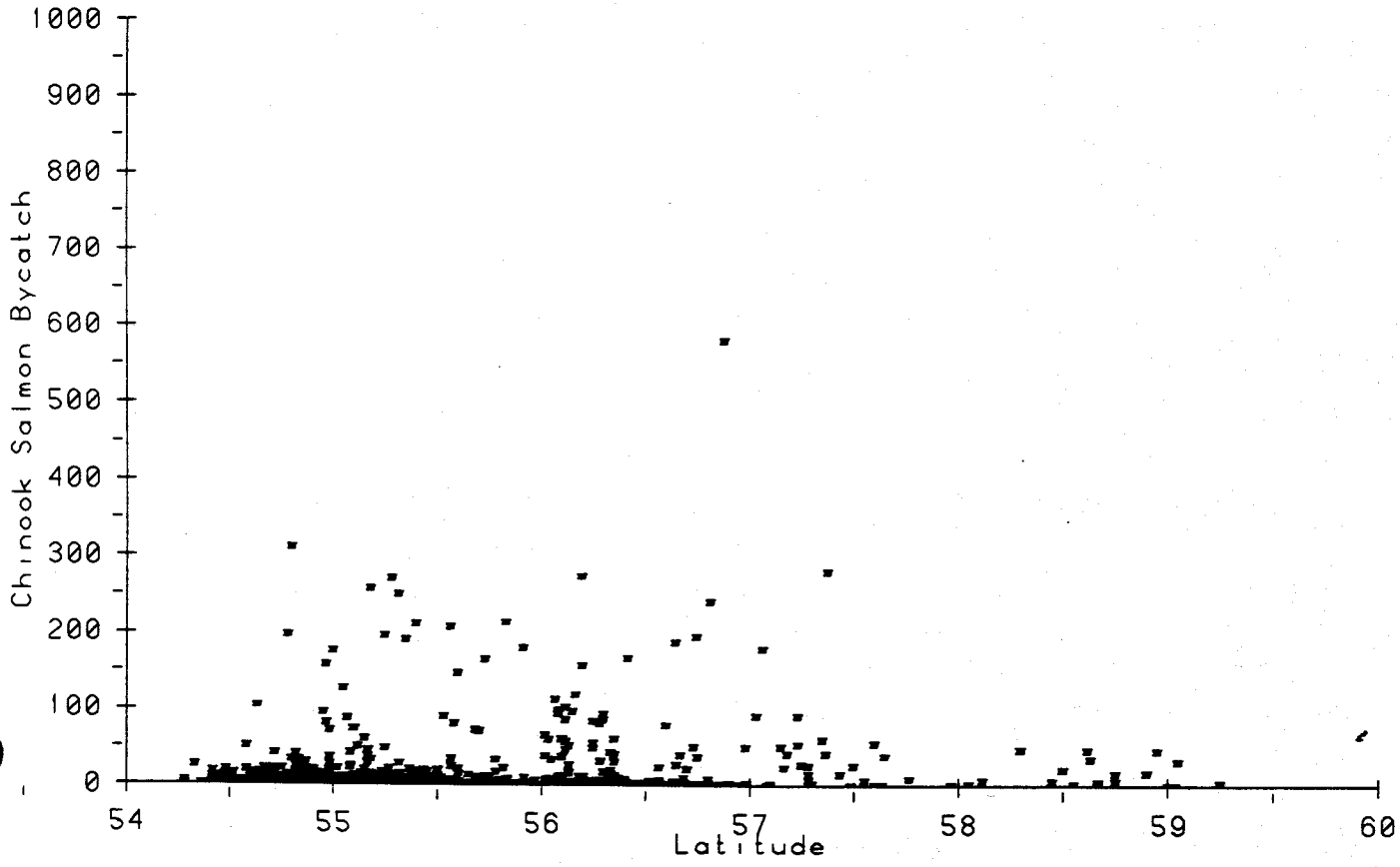
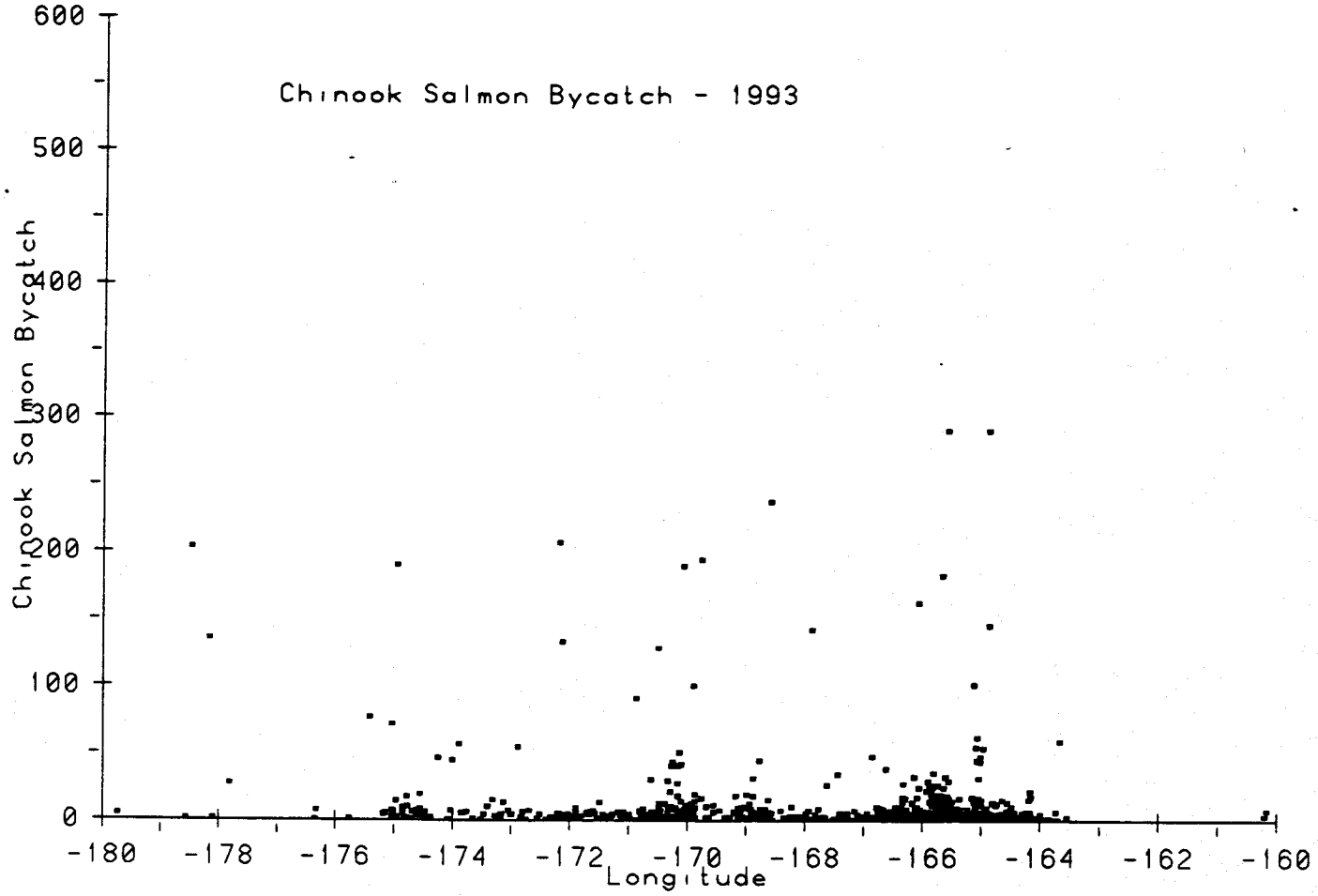
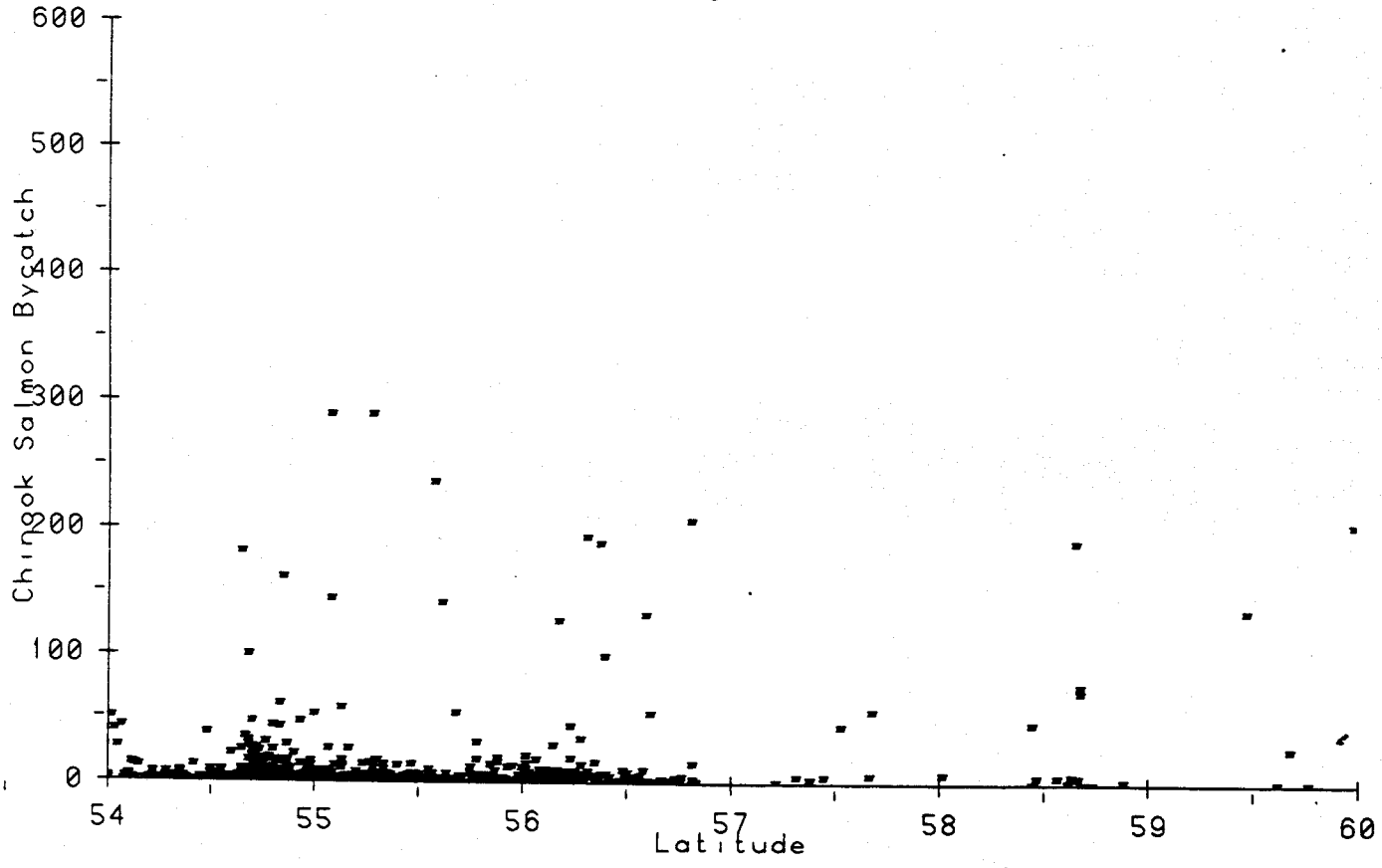


Figure 26. Bycatch of chinook salmon from observed hauls in 1993. Horizontal axes are the longitude and latitude locations of the observed hauls.





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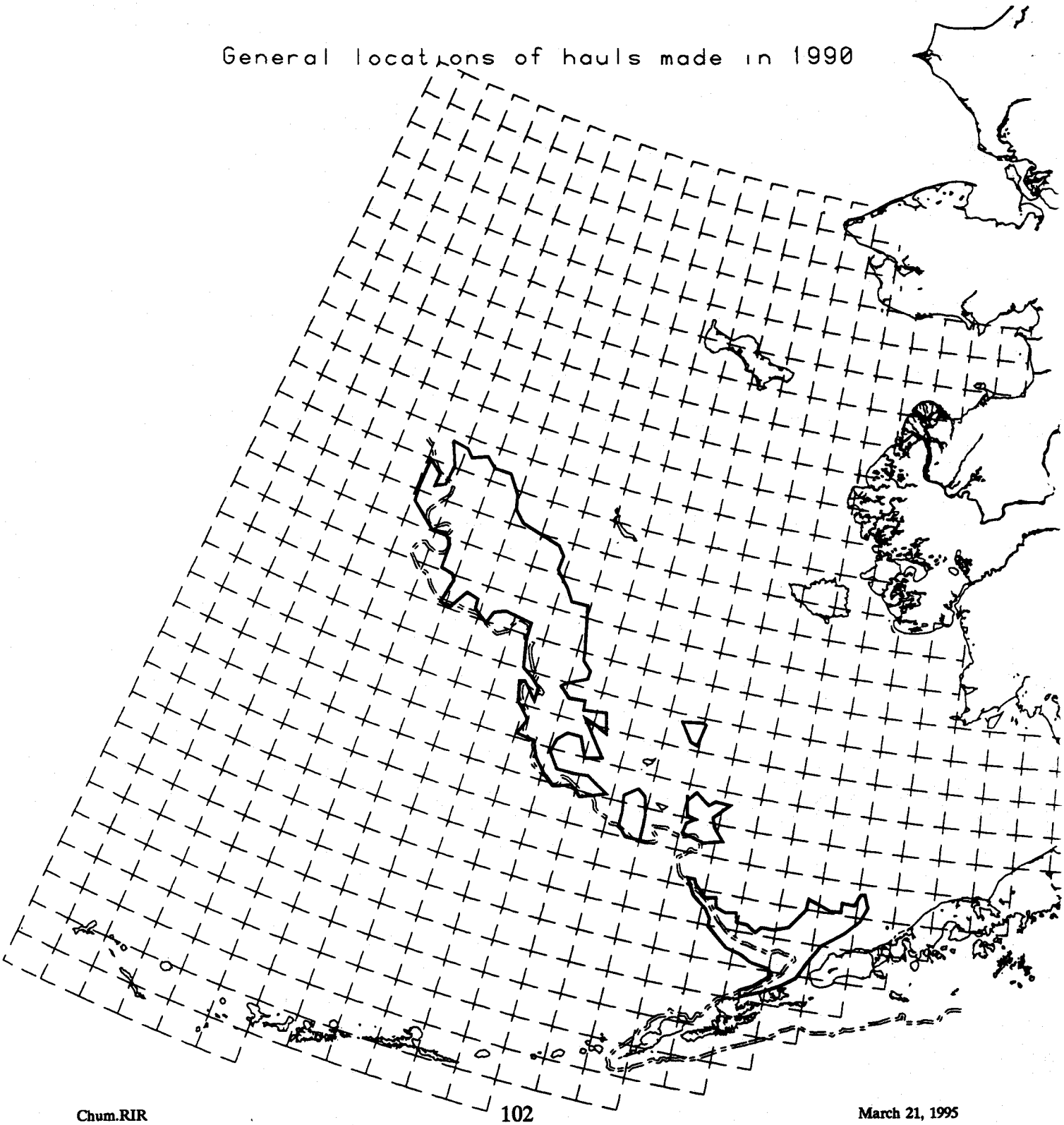


Figure 28. Location of observed trawls in the Bering Sea during the months of July through October in 1990 with an other salmon bycatch of more than 50 fish. The CVOA is highlighted and the 200 m contour is a dashed line.

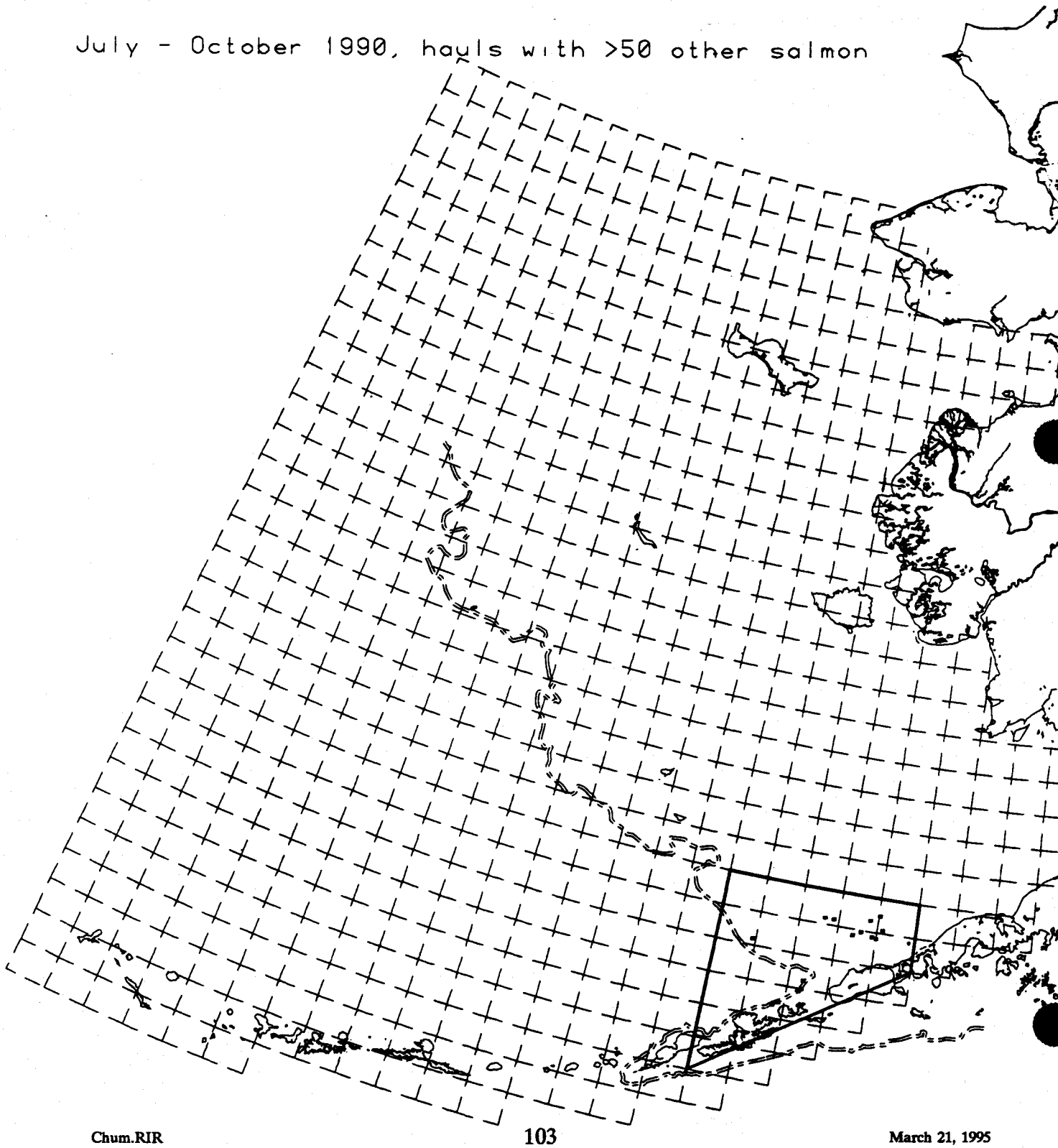


Figure 29. Outline of main concentration of observed trawls operating in the Bering Sea in 1991 during the months of July through October. Some individual hauls can occur outside of the highlighted areas. 200 m contour a dashed line.

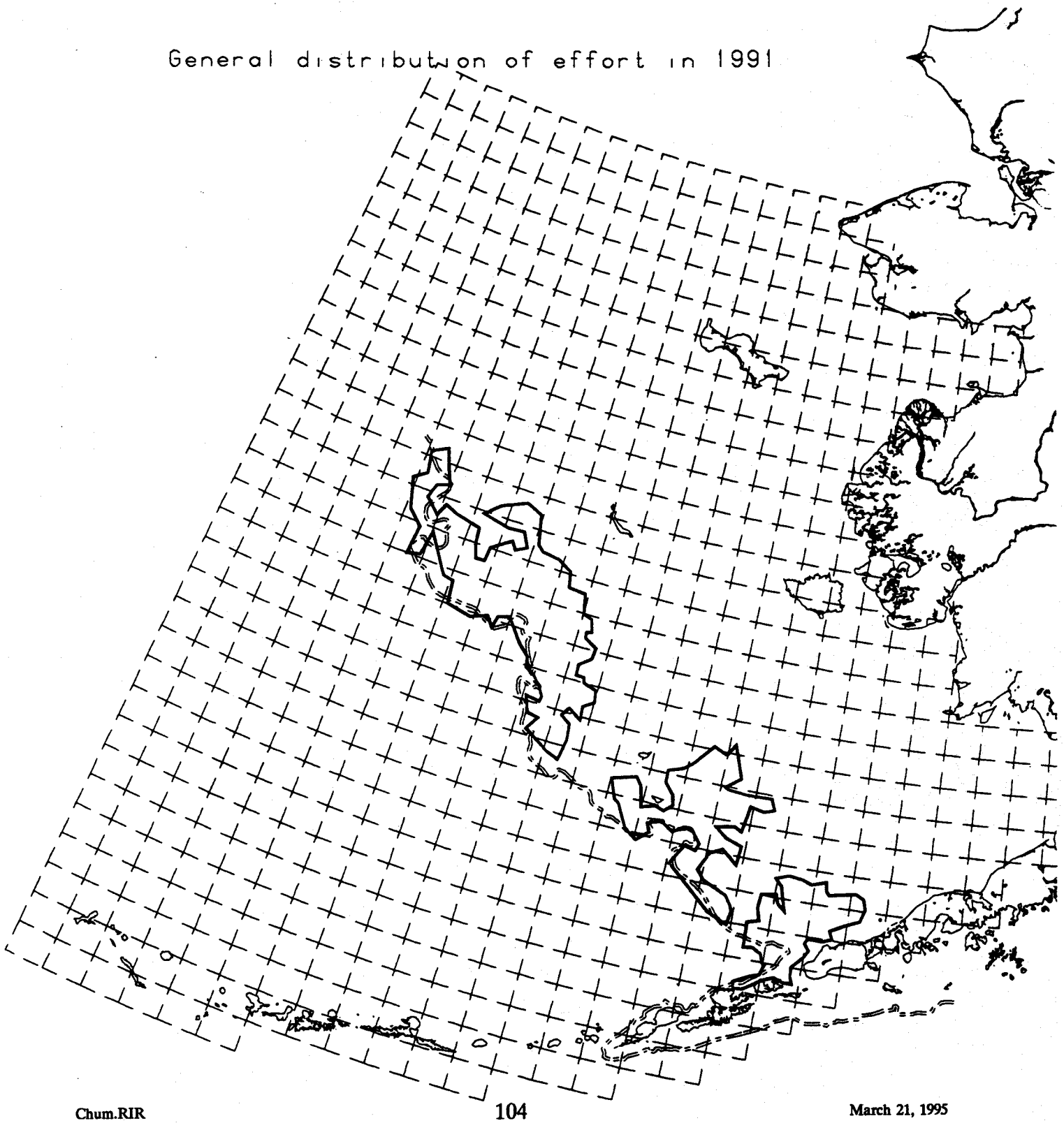


Figure 30. Location of observed trawls in the Bering Sea during the months of July through October in 1991 with an other salmon bycatch of more than 50 fish. The CVOA is highlighted and the 200 m contour is a dashed line.

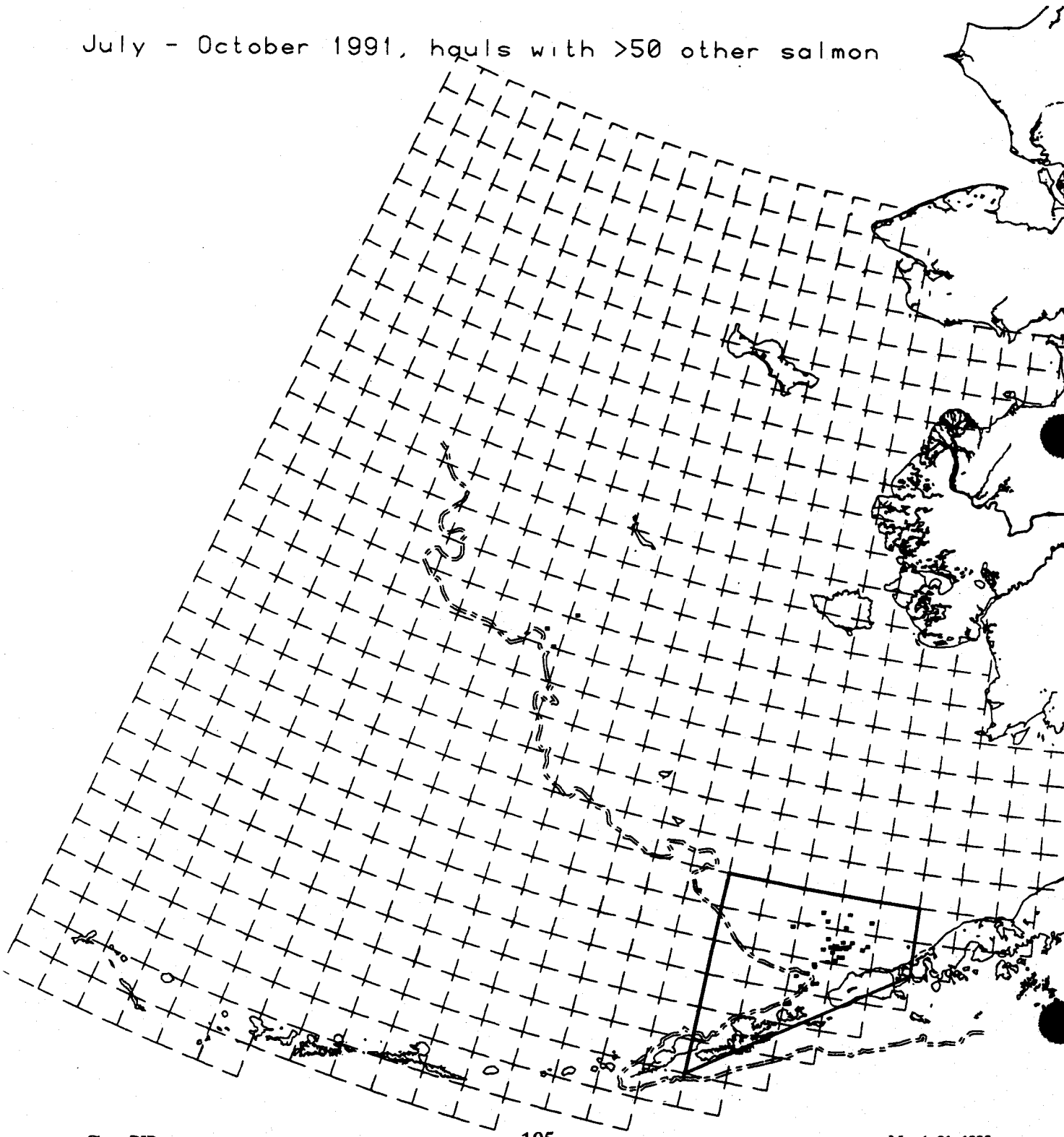


Figure 31. Outline of main concentration of observed trawls operating in the Bering Sea in 1992 during the months of July through October. Some individual hauls can occur outside of the highlighted areas. 200 m contour a dashed line.

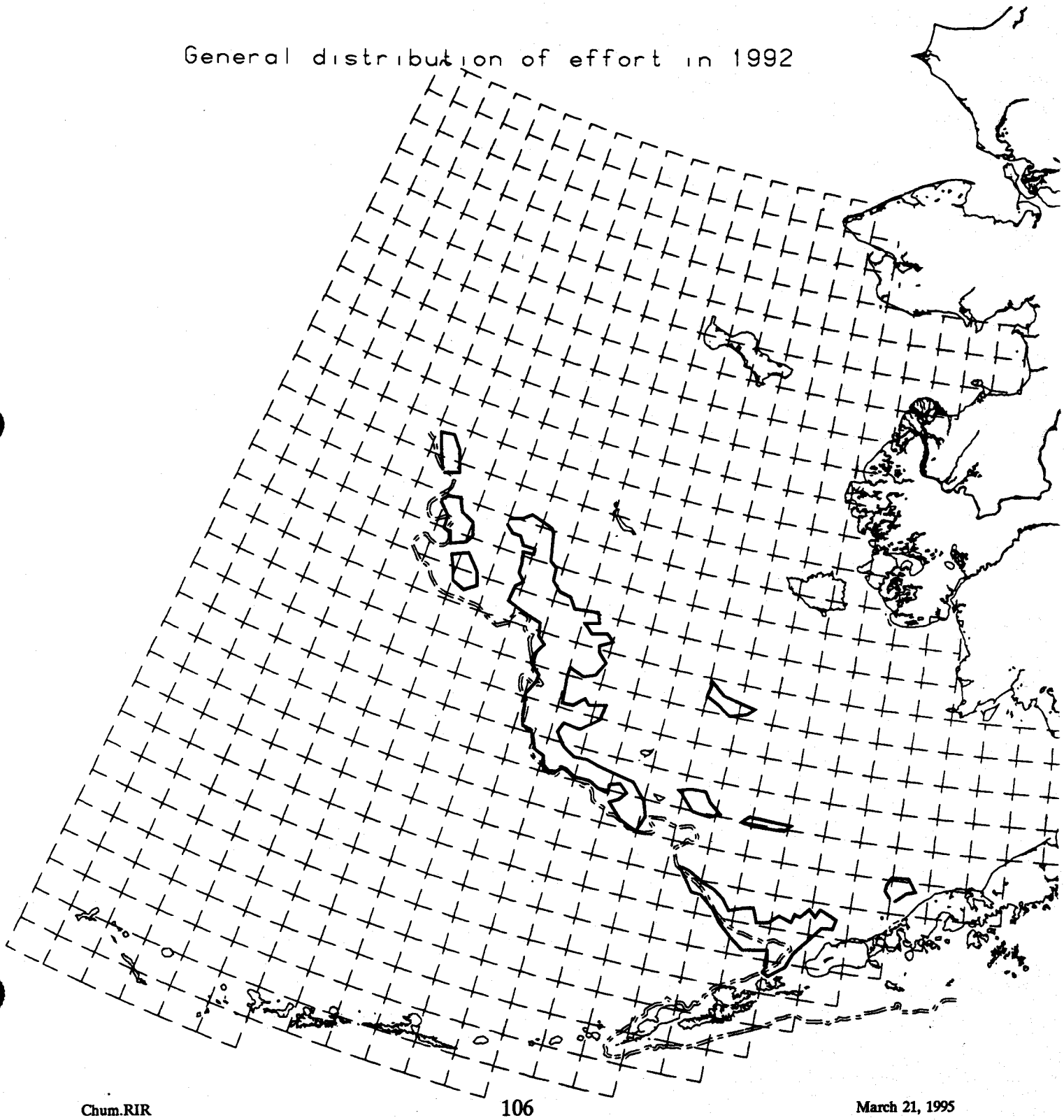


Figure 32. Location of observed trawls in the Bering Sea during the months of July through October in 1992 with an other salmon bycatch of more than 50 fish. The CVOA is highlighted and the 200 m contour is a dashed line.

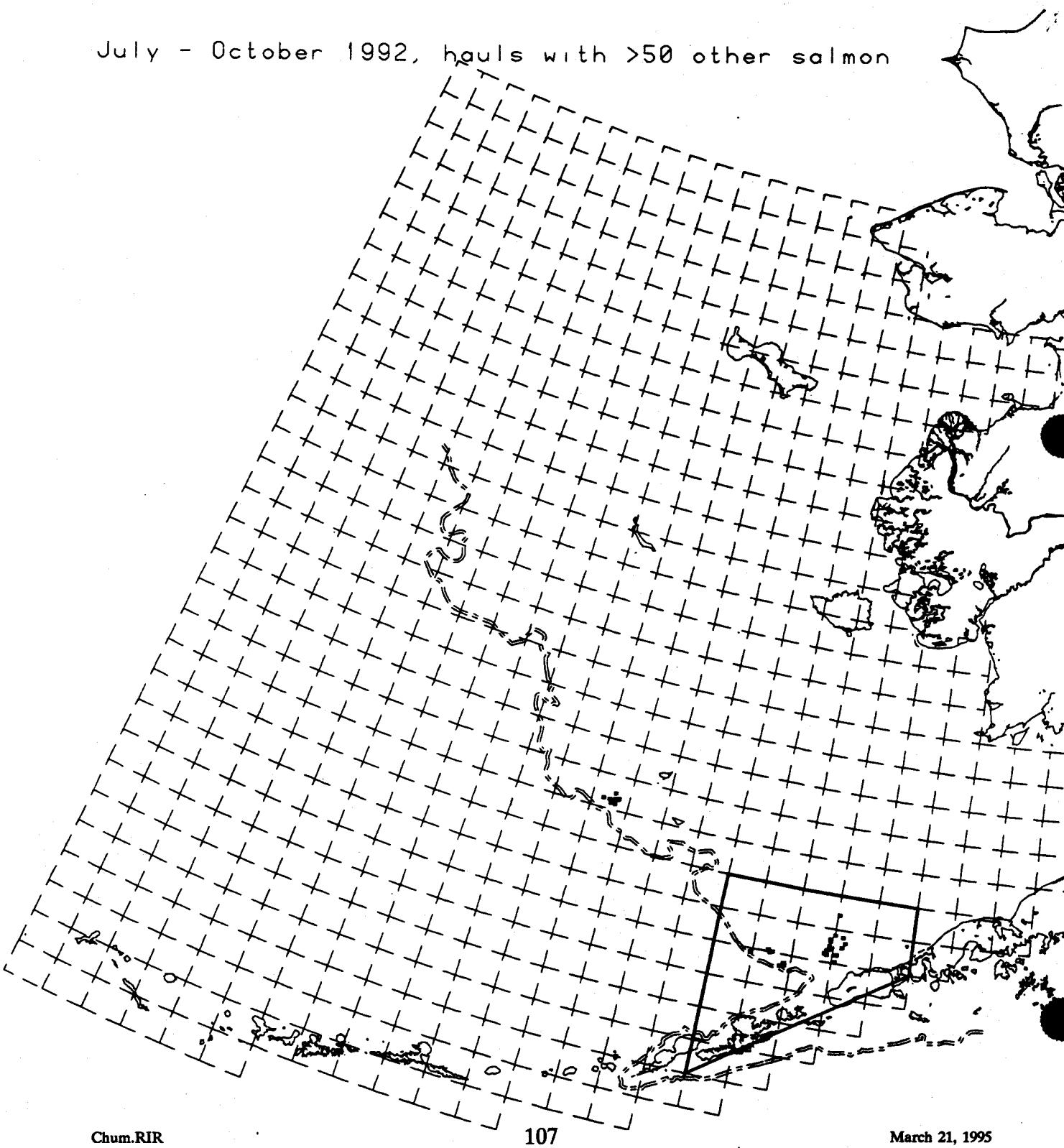


Figure 33. Outline of main concentration of observed trawls operating in the Bering Sea in 1993 during the months of July through October. Some individual hauls can occur outside of the highlighted areas. 200 m contour a dashed line.

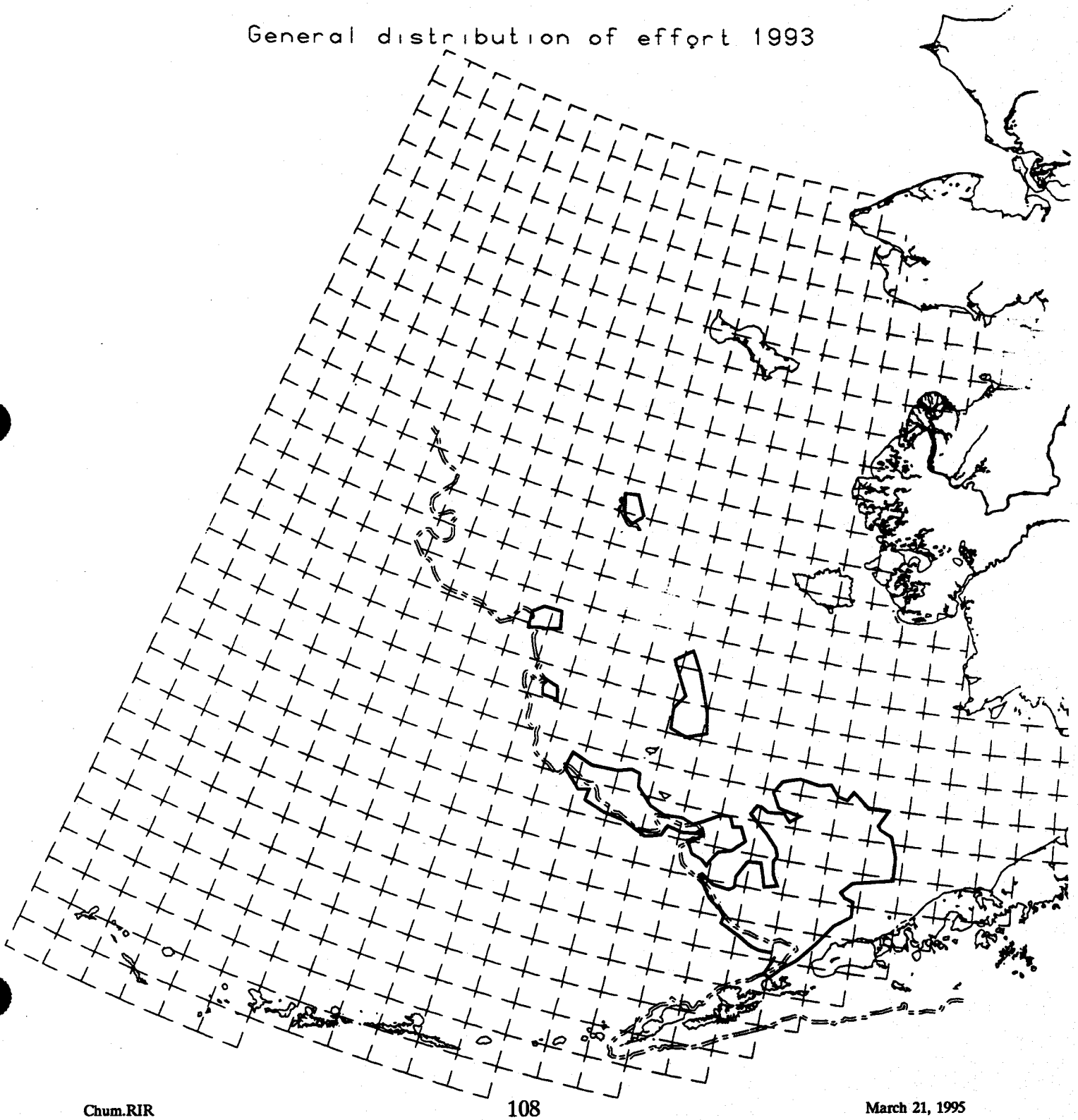


Figure 34. Location of observed trawls in the Bering Sea during the months of July through October in 1993 with an other salmon bycatch of more than 50 fish. The CVOA is highlighted and the 200 m contour is a dashed line.

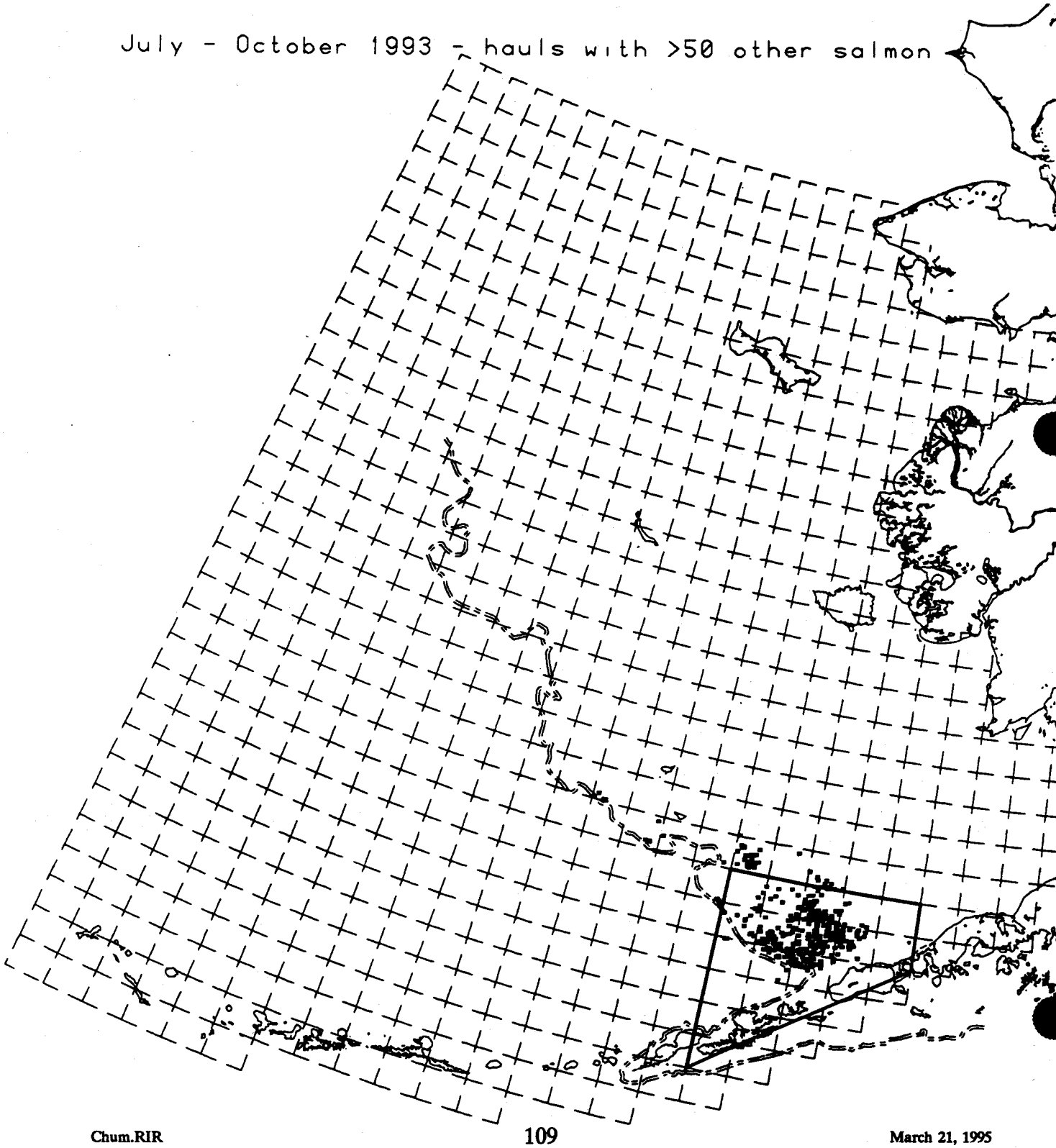
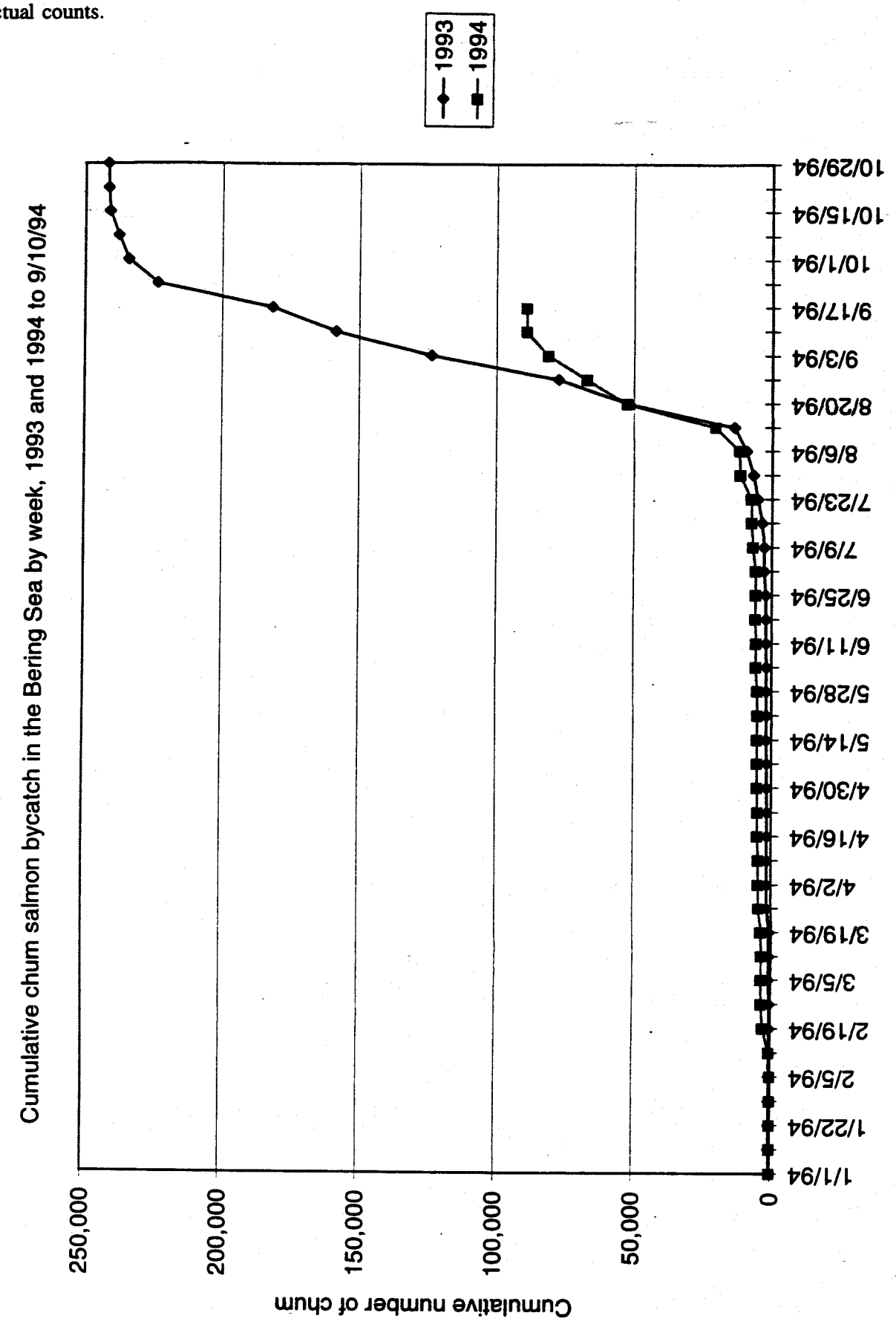


Figure 35. Cumulative weekly bycatch of other salmon from the Bering Sea trawl fisheries in 1993 and 1994 as reported on the NMFS Bulletin Board for identified target species. Estimates are expanded as in 1993, and not actual counts.



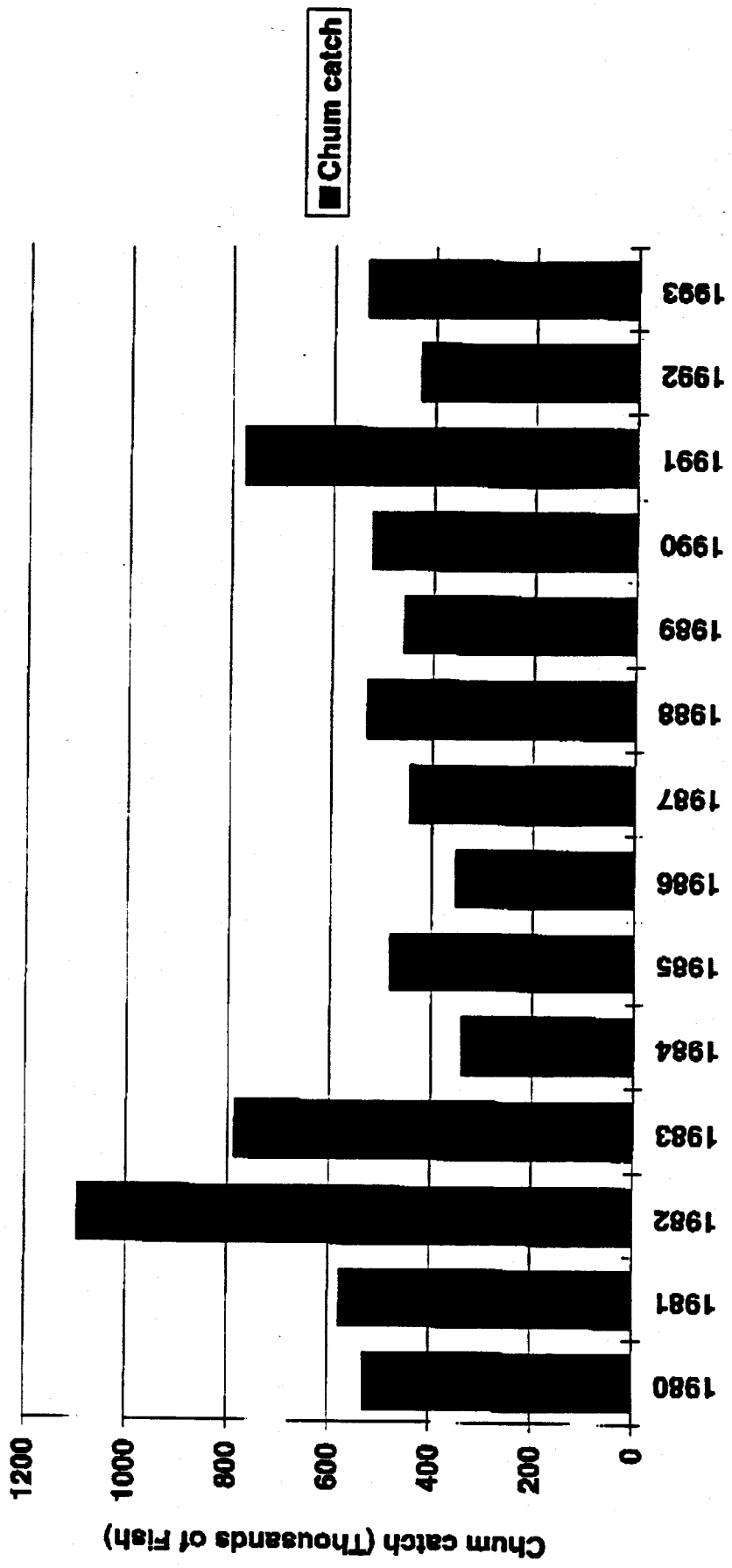


Figure 35a. **Chum catch in the South Unimak and Shumagin Islands June fisheries, 1980-1993.**

Figure 36. Reproduced from: McRoy et al. 1985. "The shelf of the Bering Sea showing the approximate locations (X X X X X) of the inner (ca. 50 m isobath), middle (ca. 100 m isobath) and shelf-break (ca. 170 m isobath) fronts which divide the shelf into distinct oceanographic domains".

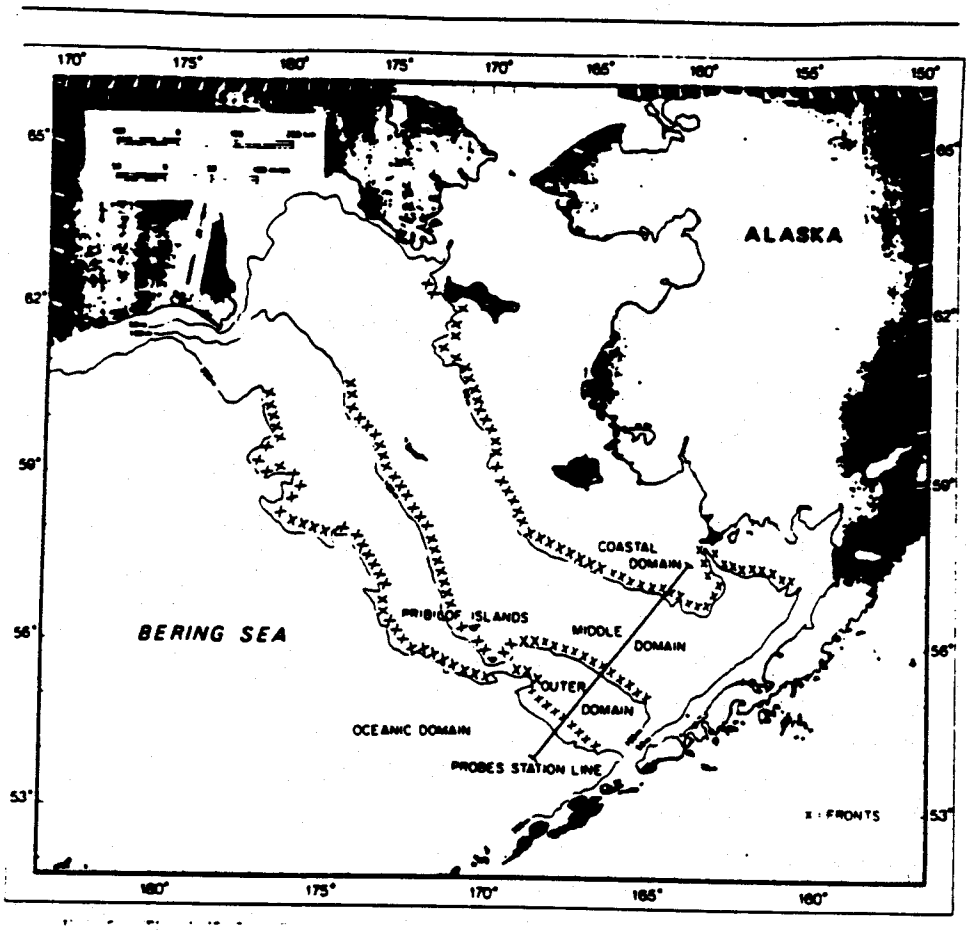


Figure 37. Reproduced from: McRoy et al. 1985. "The consequences of the Cross-Shelf Model applied to organic matter partitioning and subsequent distributions of zooplankton and seabirds (Modified from Niebauer et al. 1981)".

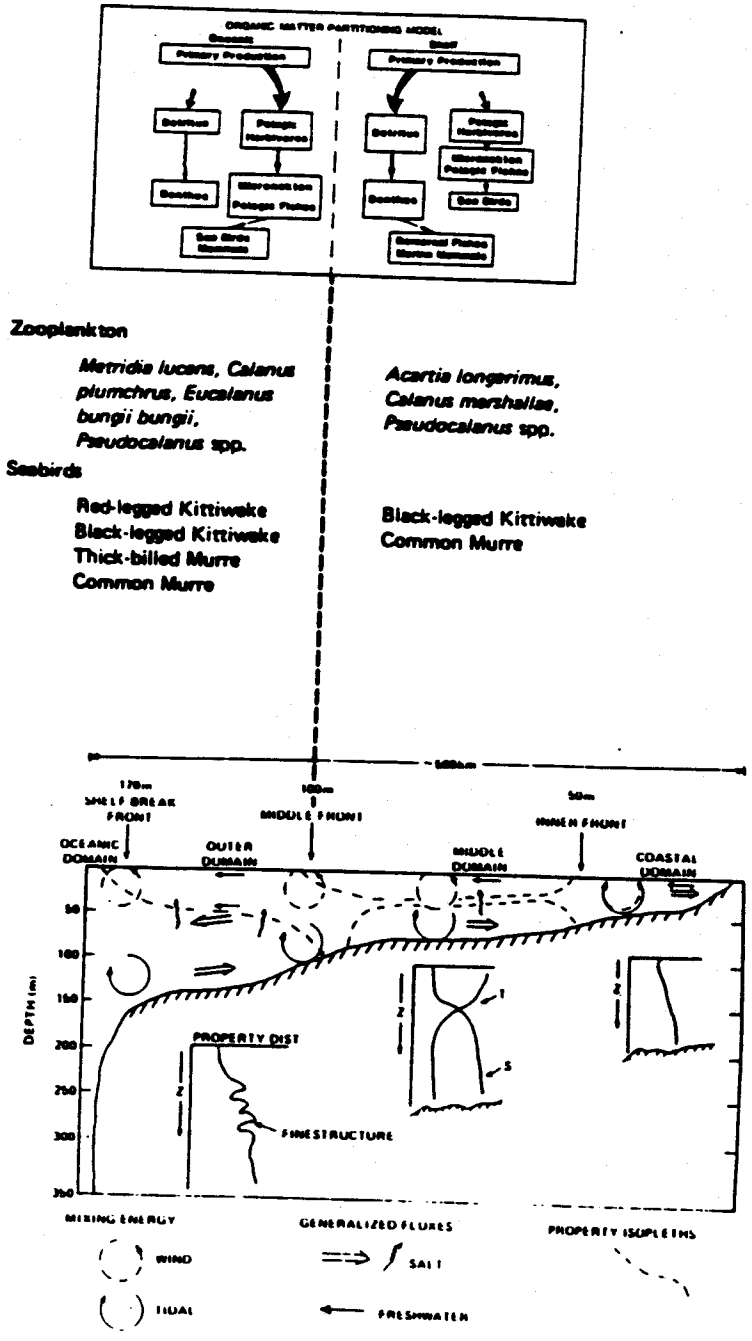
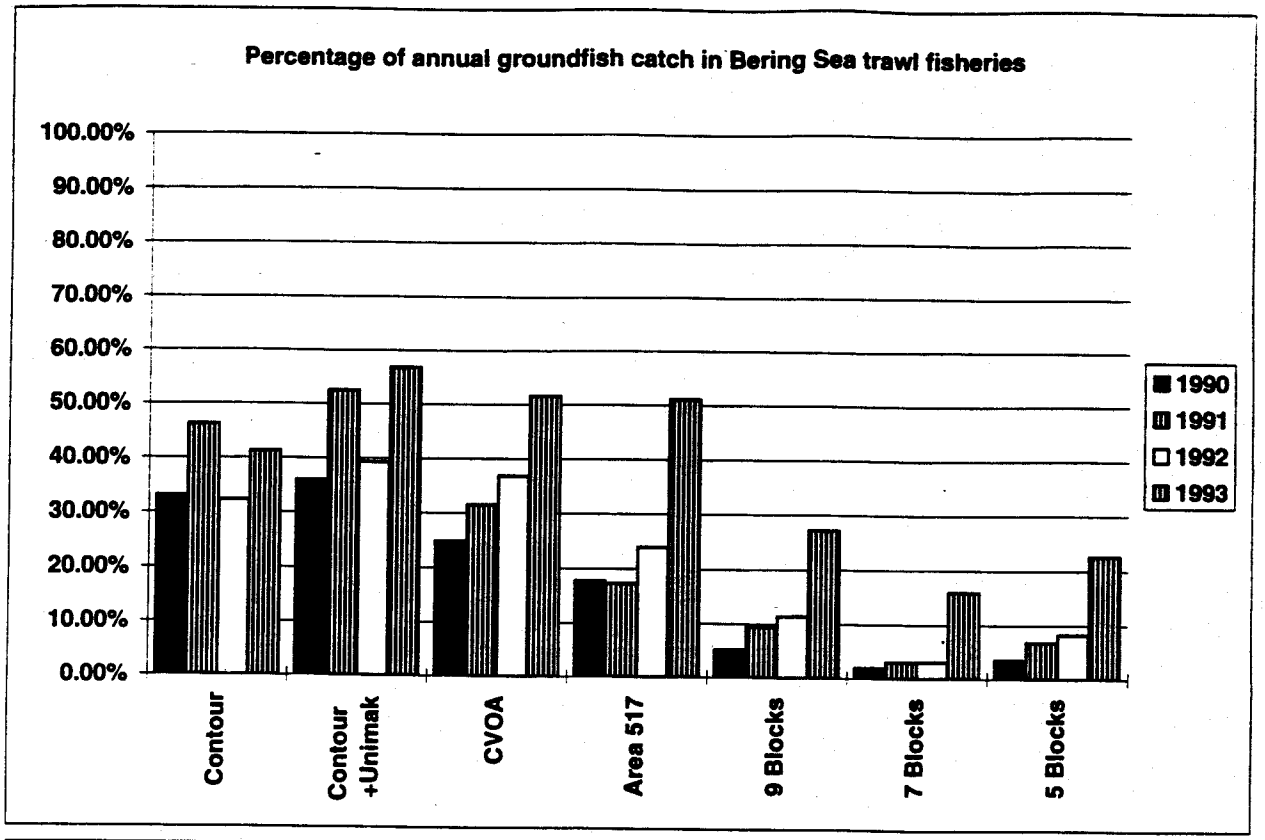


Figure 38. Top: Percentage of total annual groundfish catch from Bering Sea trawl fisheries by alternative areas. Bottom: Groundfish catch taken during the months July through October expressed as a percentage of total annual groundfish catch.



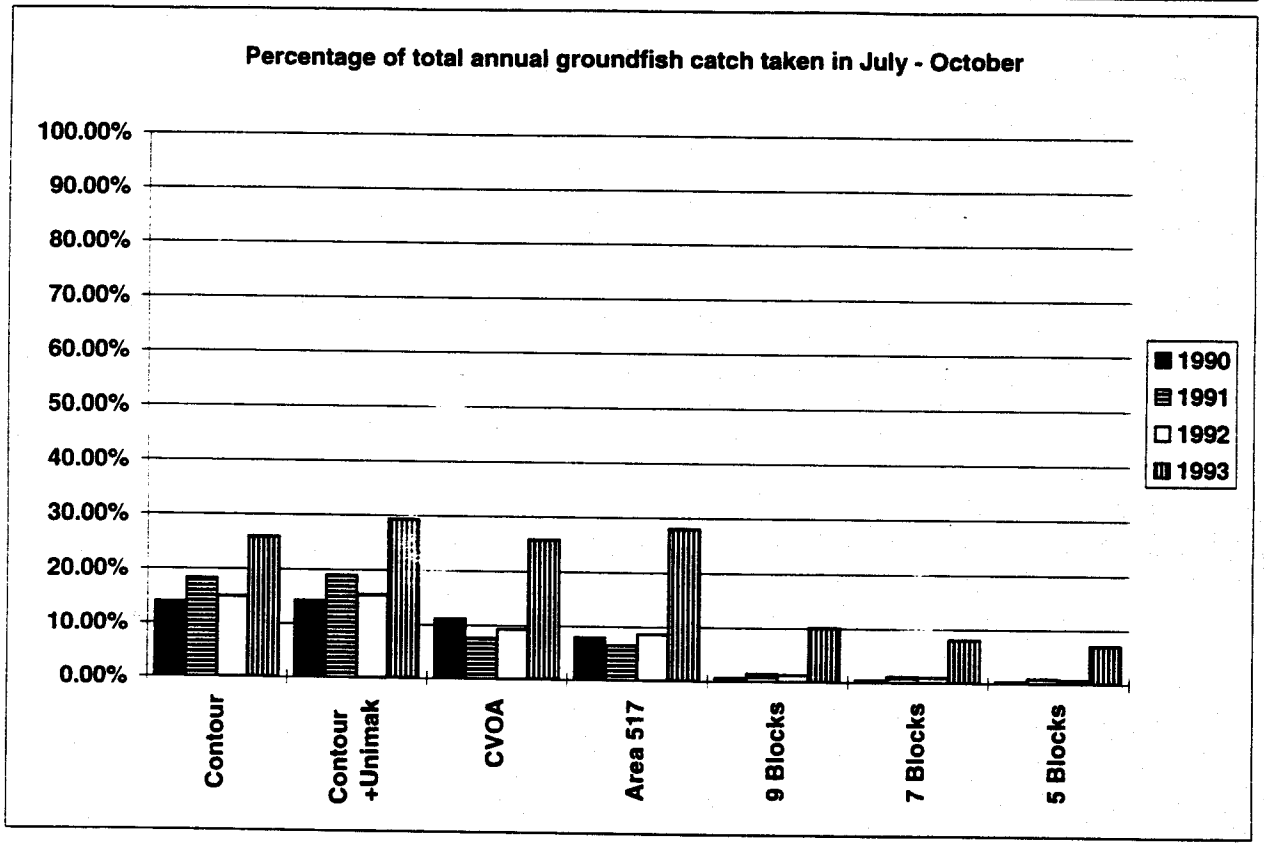


Figure 39. Top: Percentage of total annual other salmon bycatch from Bering Sea trawl fisheries by optional areas. Bottom: Other salmon bycatch from the months July through October expressed as a percentage of total annual other salmon bycatch.

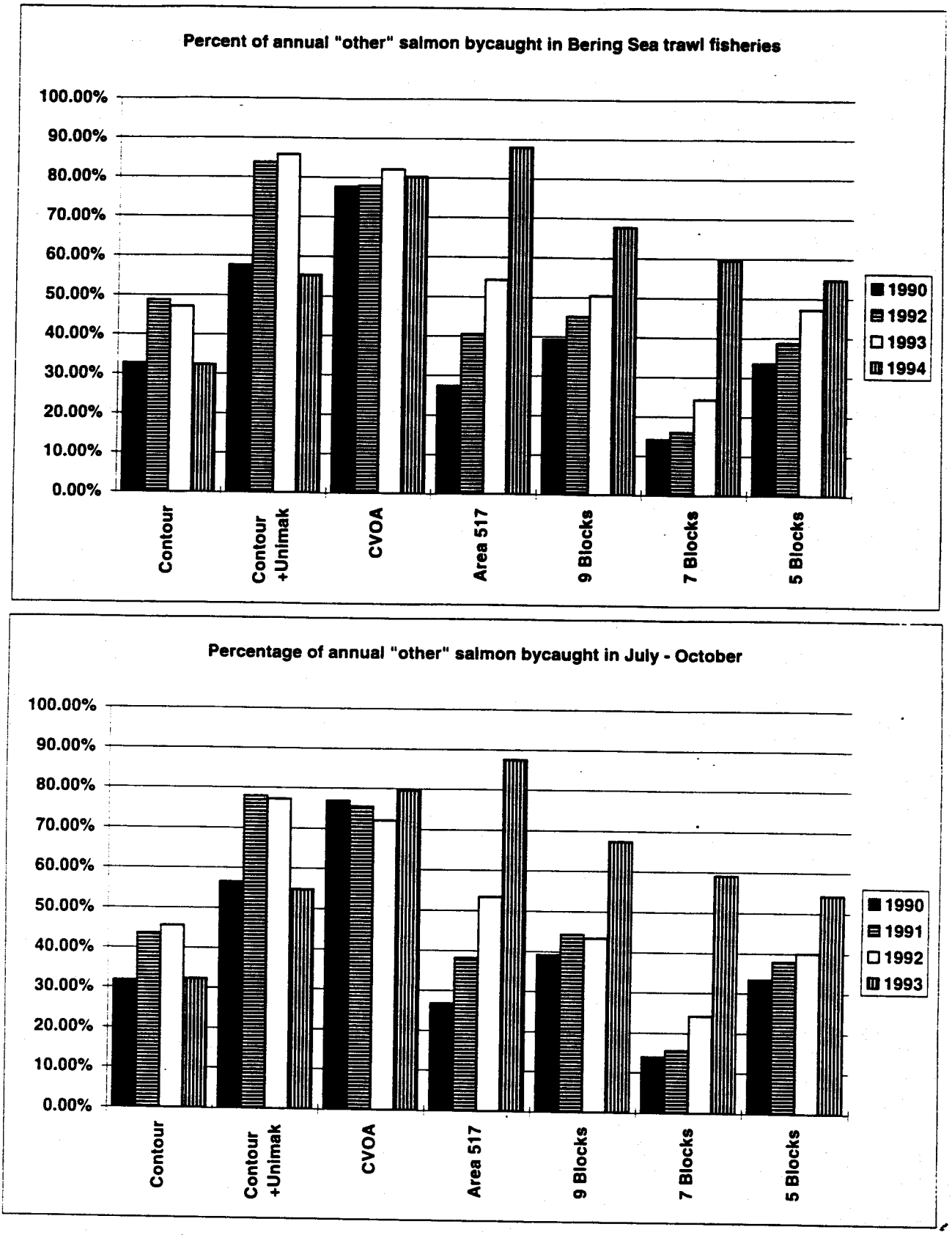


Figure 40. Bering Sea divided into 5 mutually exclusive areas. Top: The percentage of the number of annual hauls from each of 5 non-overlapping areas. Bottom: The percentage of total annual groundfish catch from each of 5 non-overlapping areas.

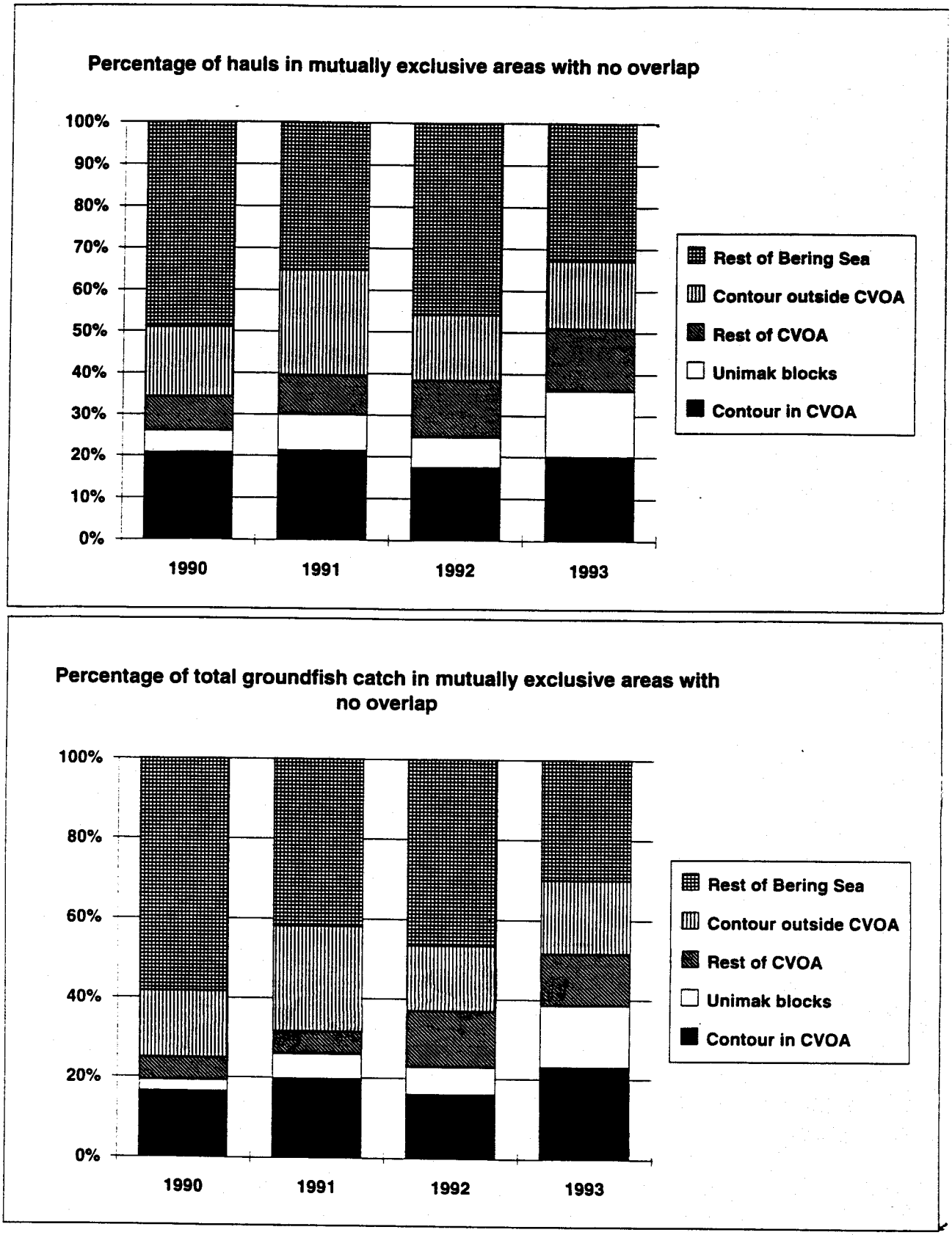
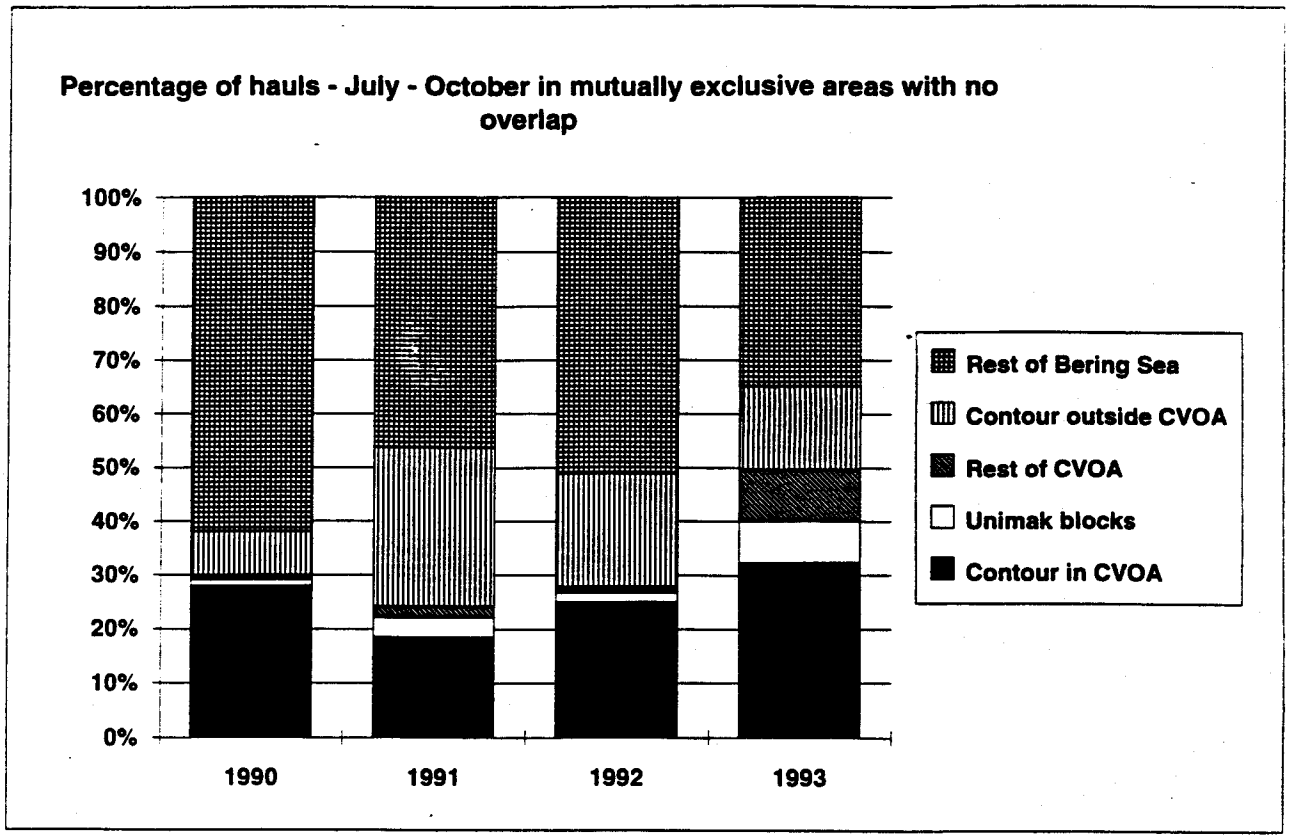


Figure 41. Bering Sea divided into 5 mutually exclusive areas. Top: The percentage of the number of annual hauls from each of 5 non-overlapping areas during July-October. Bottom: The percentage of total annual groundfish catch from each of 5 non-overlapping areas during July-October.



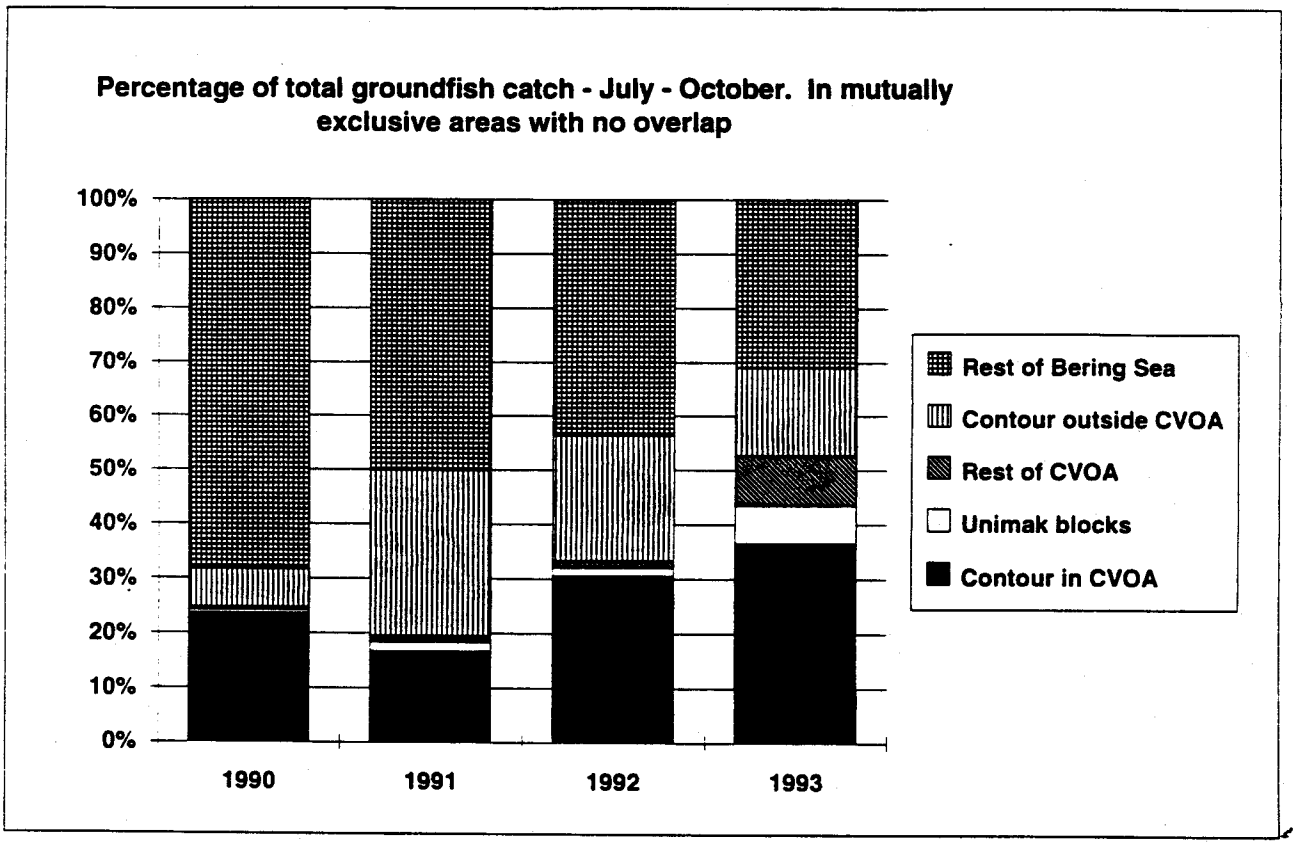
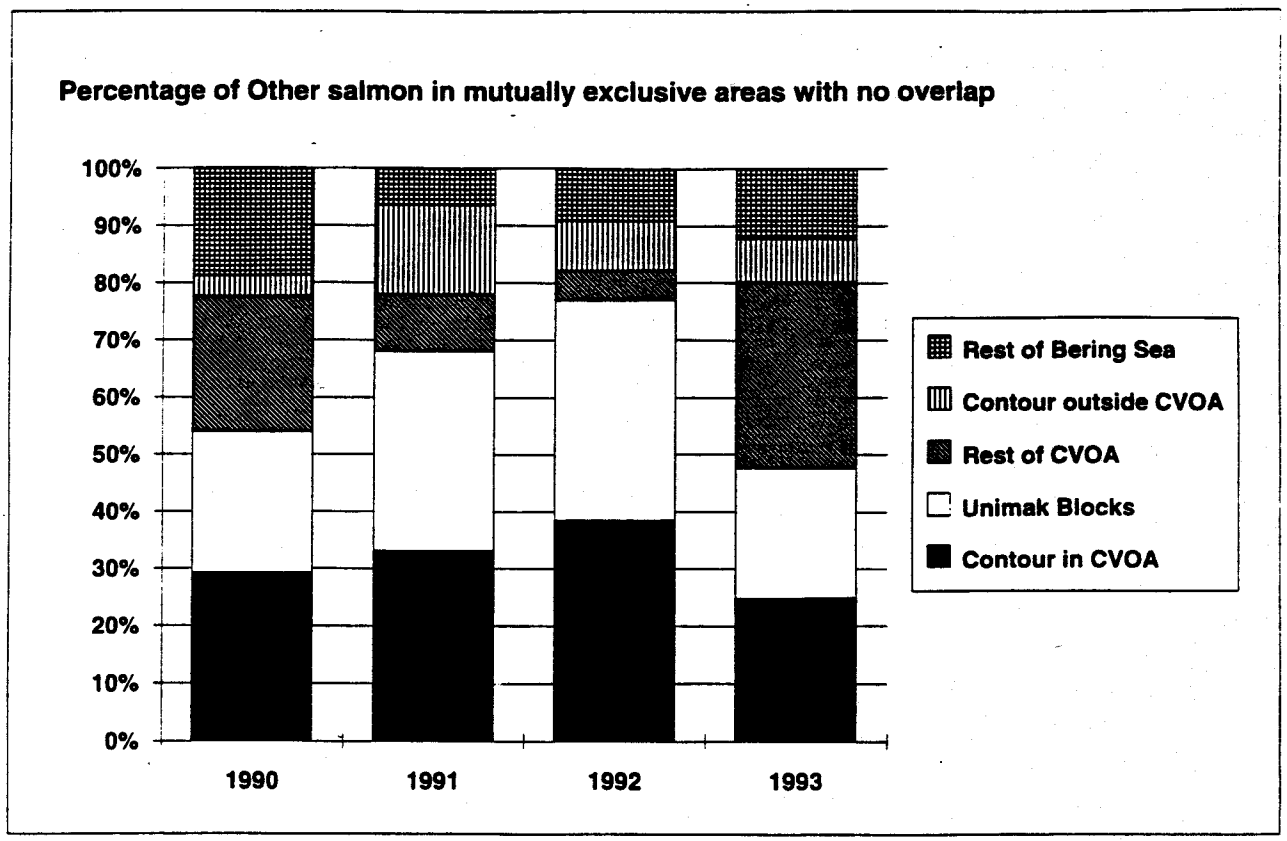


Figure 42. Bering Sea divided into 5 mutually exclusive areas. Top: The percentage of other salmon bycaught in each of 5 non-overlapping areas. Bottom: The percentage of total annual other salmon bycatch taken in each of 5 non-overlapping areas during the months July-October.



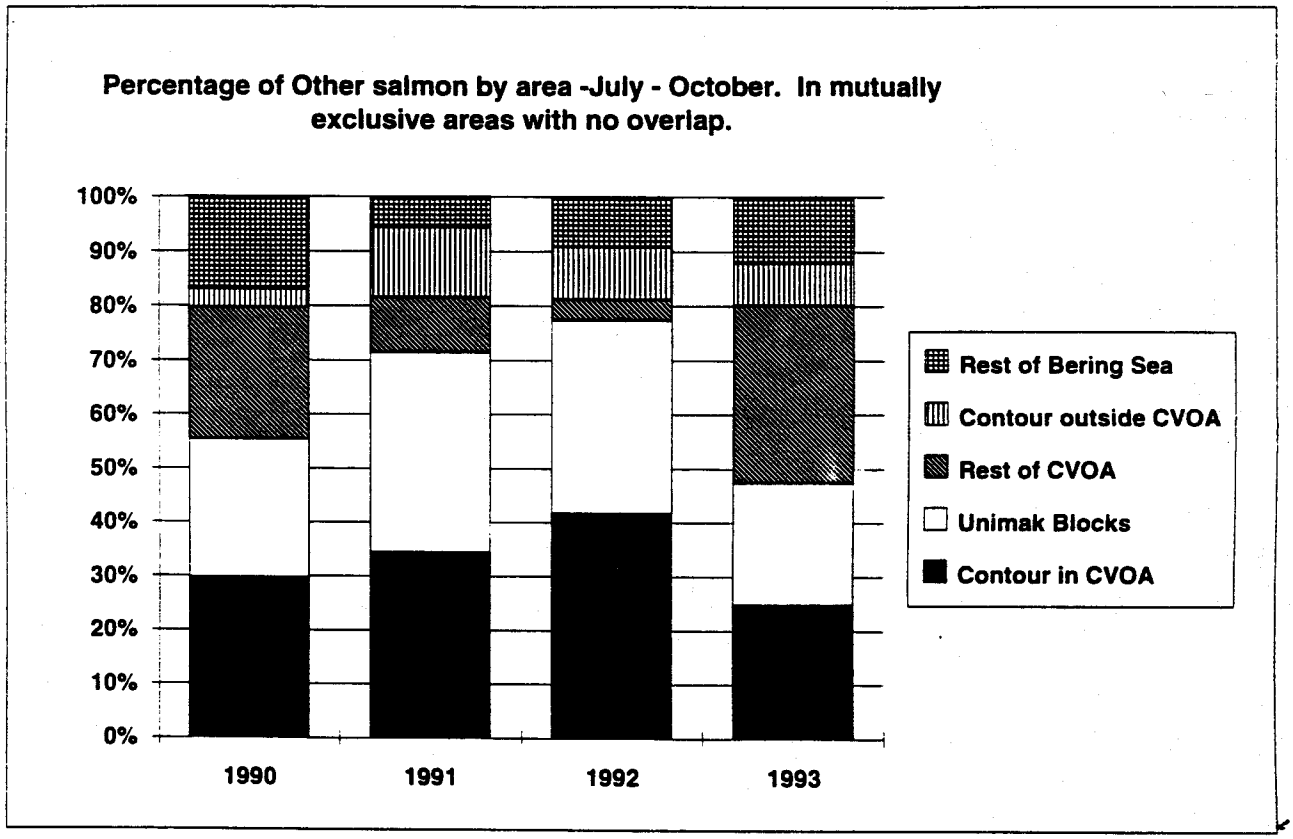


Figure 43. Rate of bycatch by area expressed as the number of other salmon bycaught per metric ton of groundfish catch. For the months of July through October in defined areas in the BSAI.

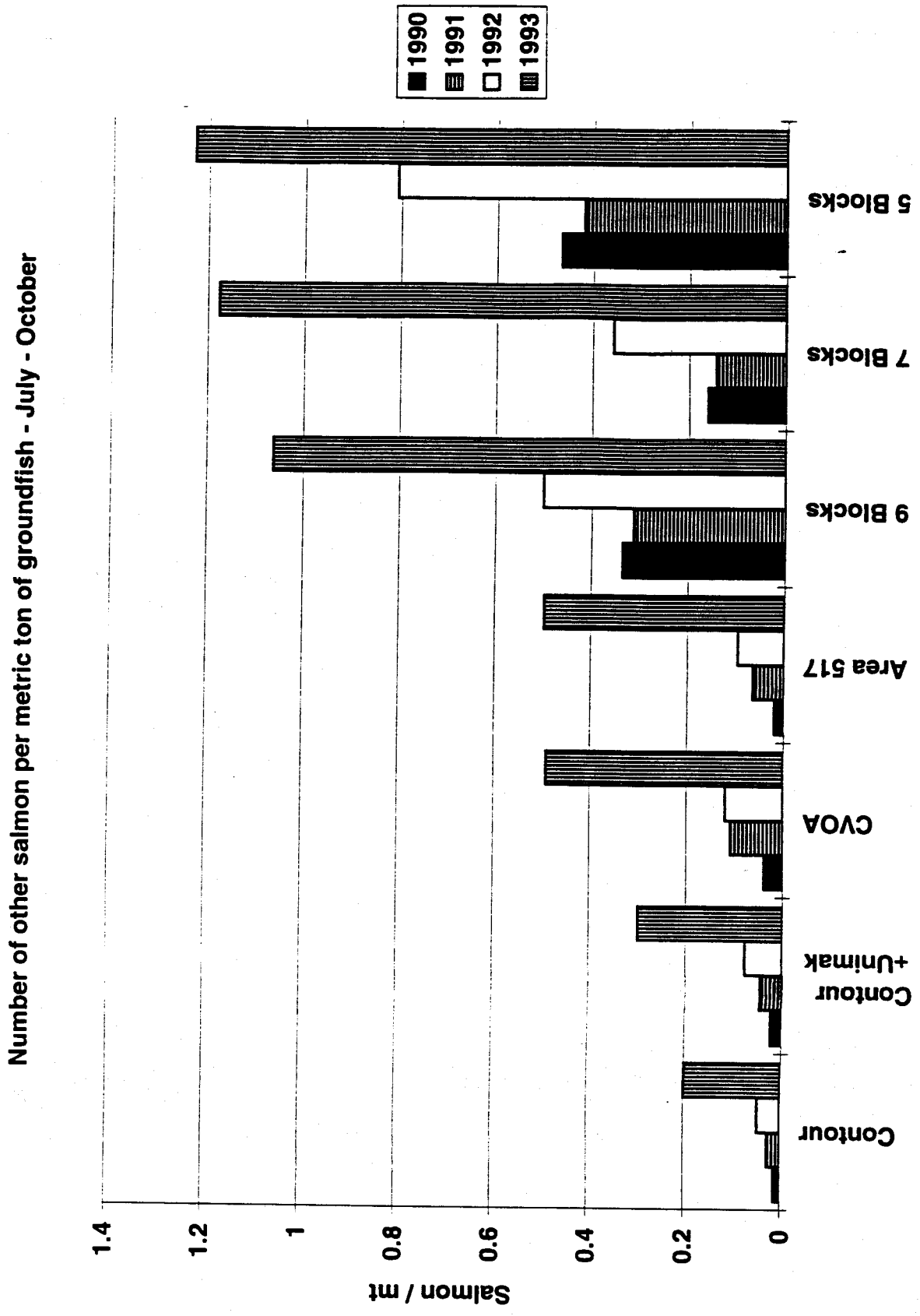


Figure 44. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1993. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is >= 34 cm.

Figure 45. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1992. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is >= 34 cm.

Figure 46. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1991. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is >= 34 cm.

Figure 47. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1990. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is >= 34 cm.

Figure 48. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1989. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is >= 34 cm.

Figure 49. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1988. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is >= 34 cm.

Figure 50. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1993. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is < 34 cm. Note scale of key differs from larger pollock display.

Figure 51. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1992. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is < 34 cm. Note scale of key differs from larger pollock display.

Figure 52. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1991. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is < 34 cm. Note scale of key differs from larger pollock display.

Figure 53. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1990. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is < 34 cm. Note scale of key differs from larger pollock display.

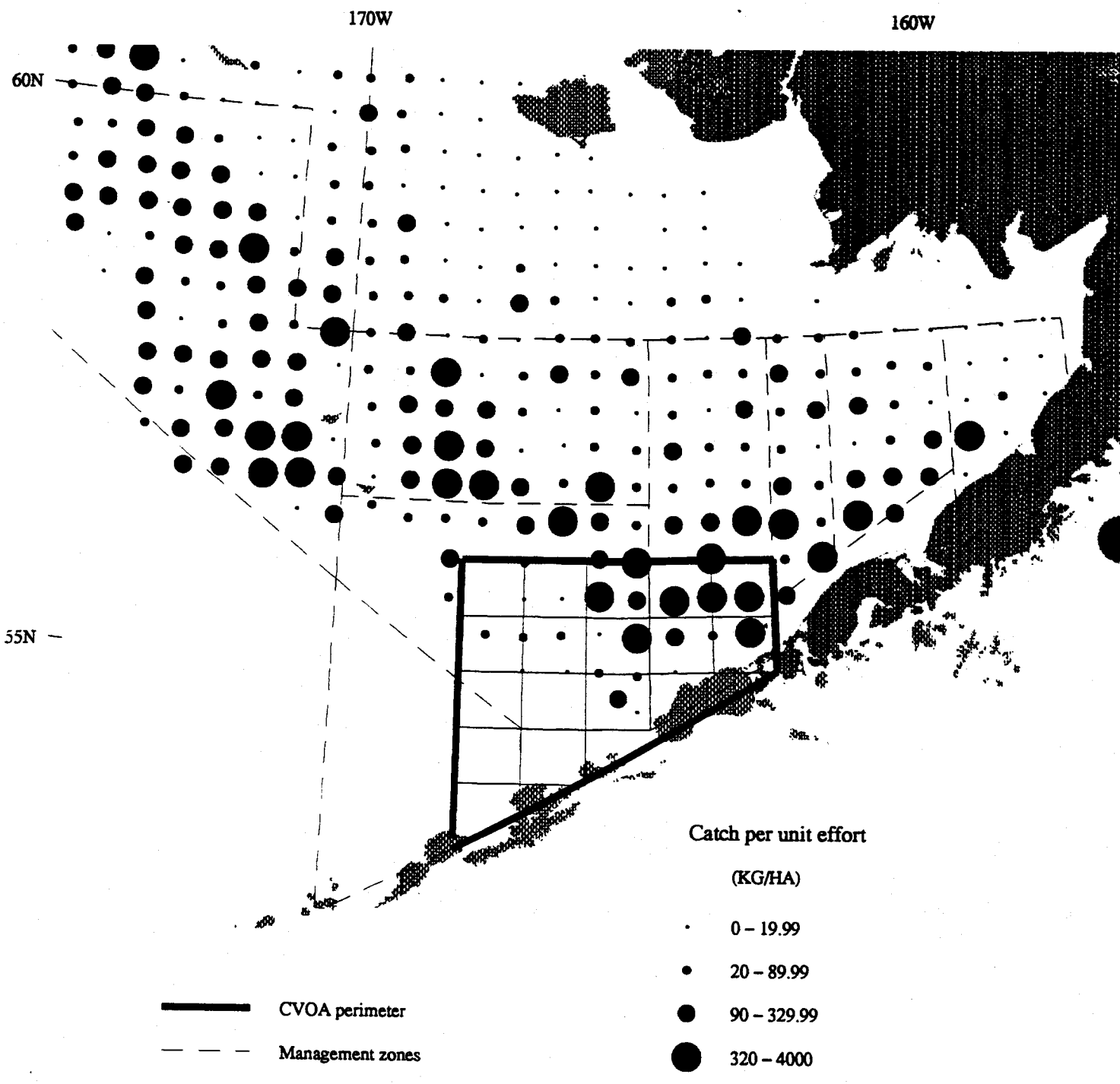
Figure 54. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1989. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is < 34 cm. Note scale of key differs from larger pollock display.

Figure 55. NMFS annual trawl survey of the Bering Sea made in mid-summer of 1988. Circles are relative to key and measures of pollock CPUE in kilograms per hectare. Survey locations are represented by dot or circle. Pollock size is < 34 cm. Note scale of key differs from larger pollock display.

Figure 44. Figure description printed prior to Figure 44.

1993 Pollock

Greater than or equal to 34 centimeters.

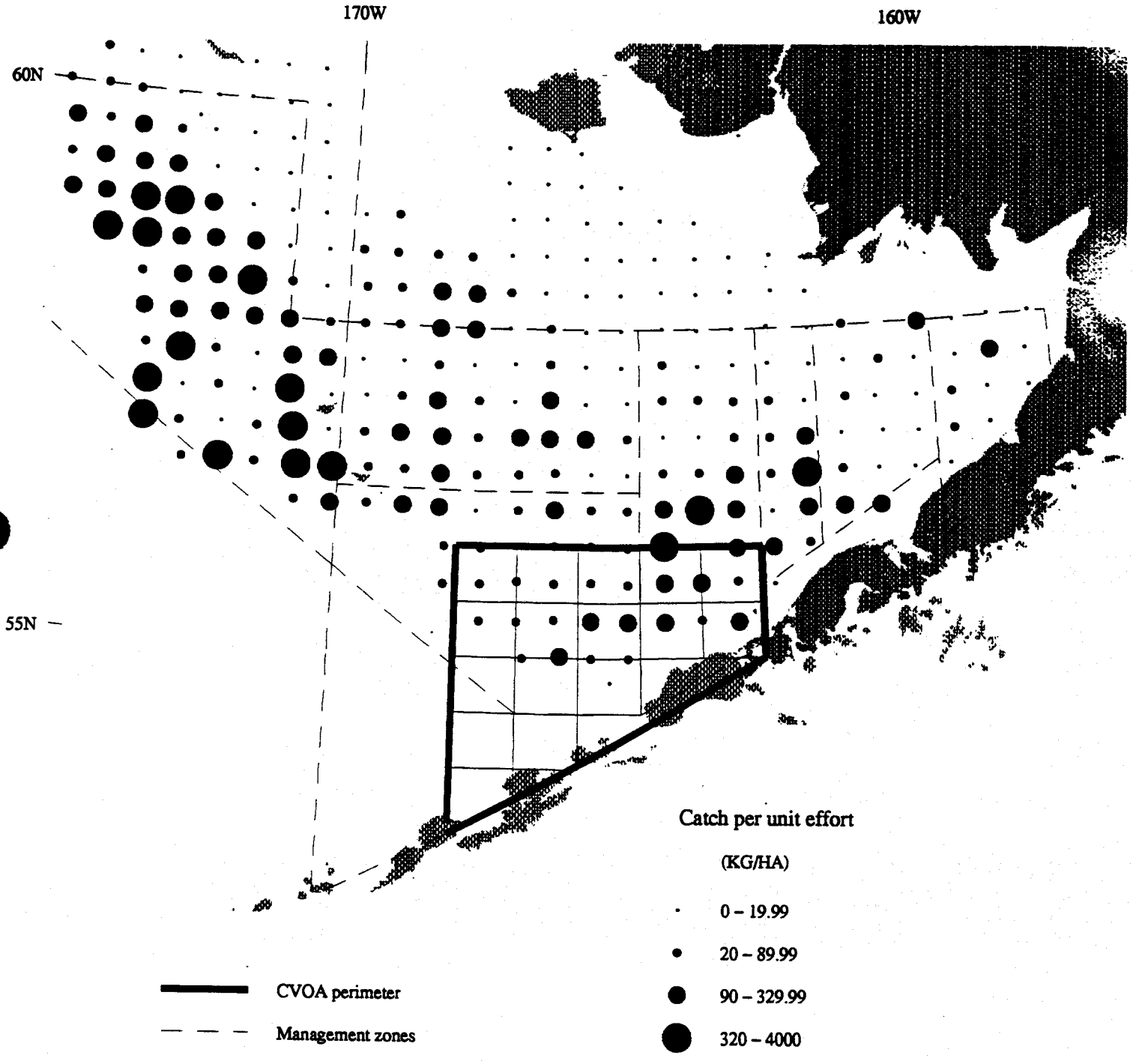


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 45. Figure description printed prior to Figure 44.

1992 Pollock

Greater than or equal to 34 centimeters.

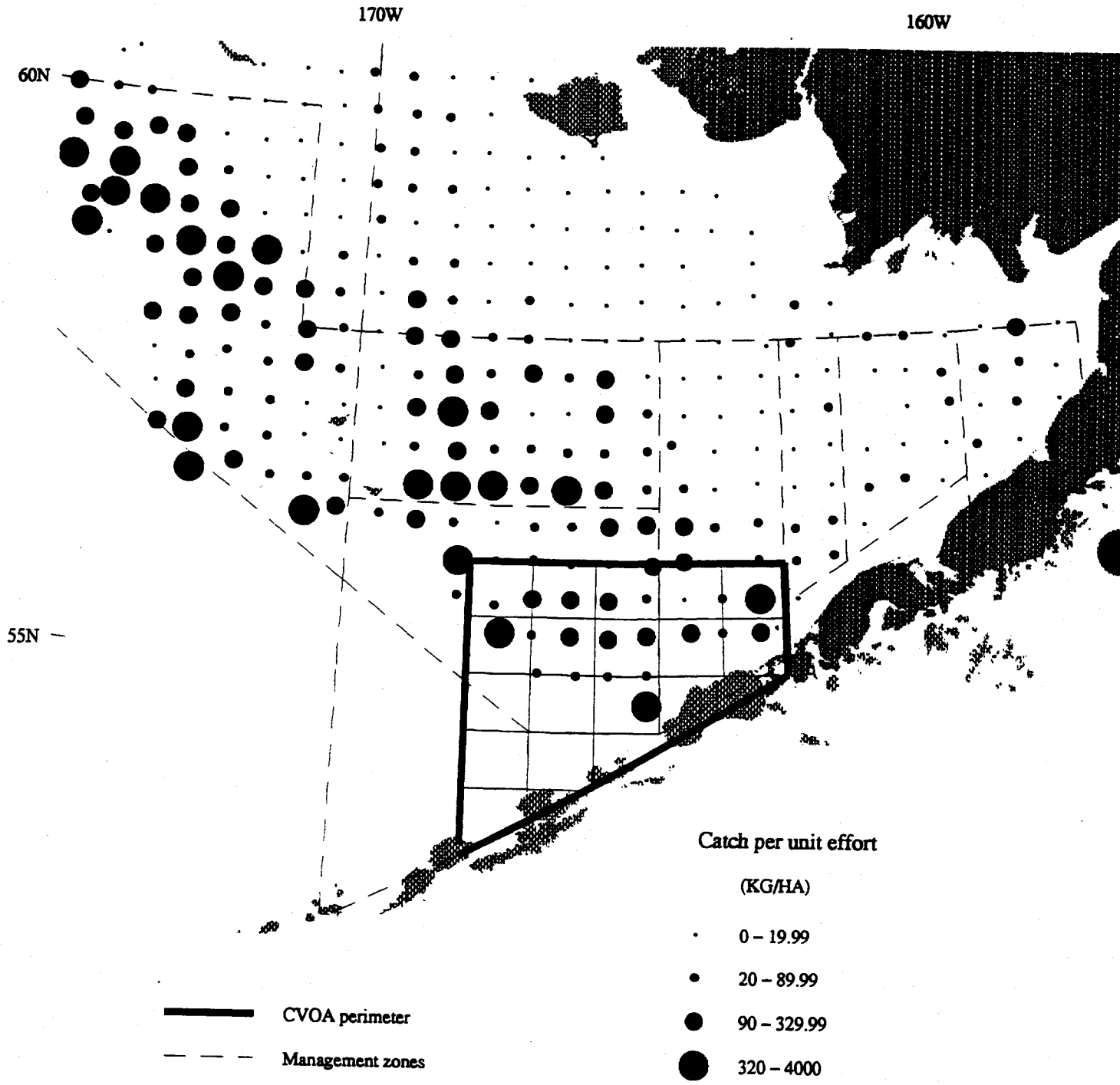


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 46. Figure description printed prior to Figure 44.

1991 Pollock

Greater than or equal to 34 centimeters.

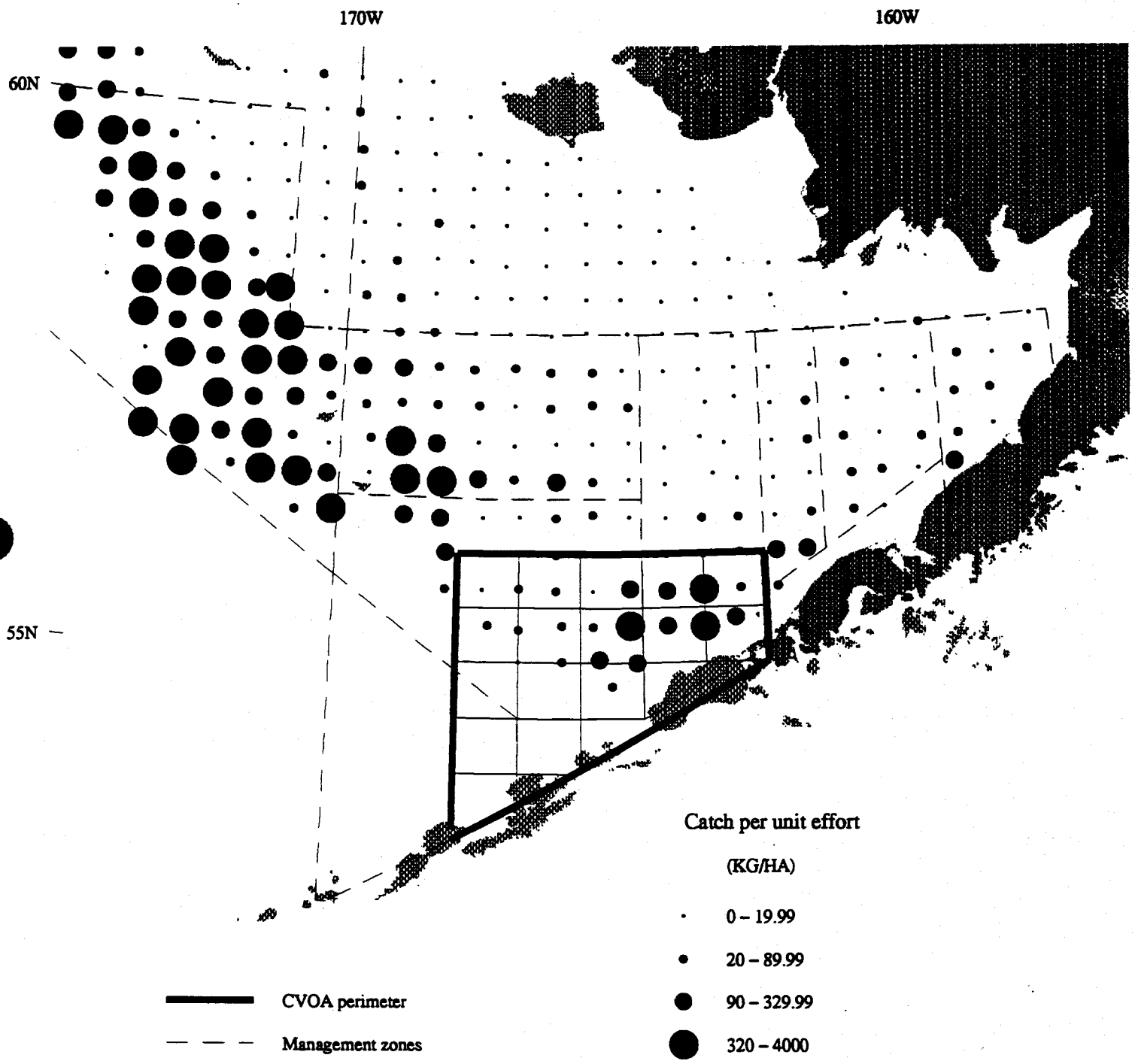


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 47. Figure description printed prior to Figure 44.

1990 Pollock

Greater than or equal to 34 centimeters.

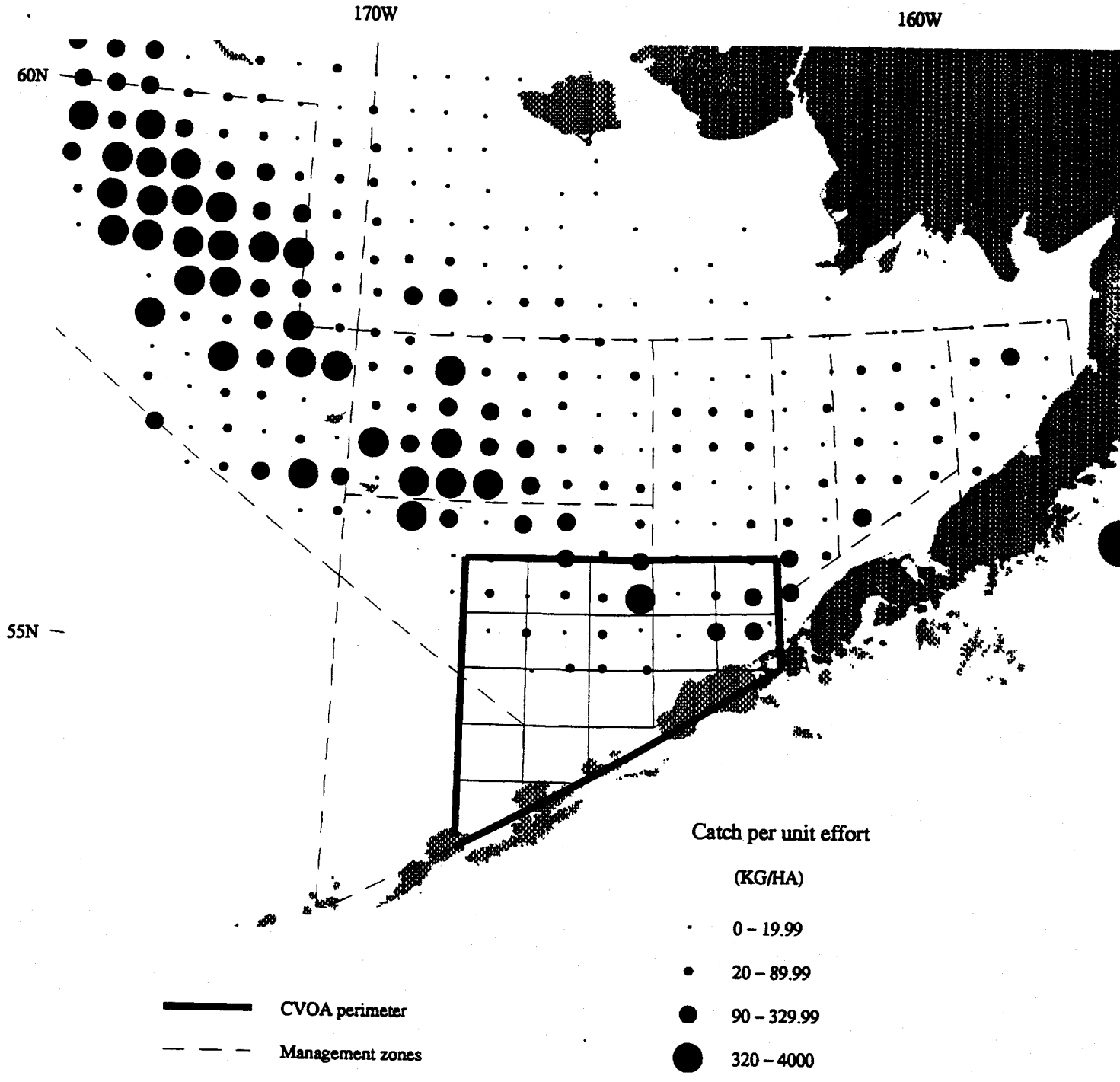


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 48. Figure description printed prior to Figure 44.

1989 Pollock

Greater than or equal to 34 centimeters.

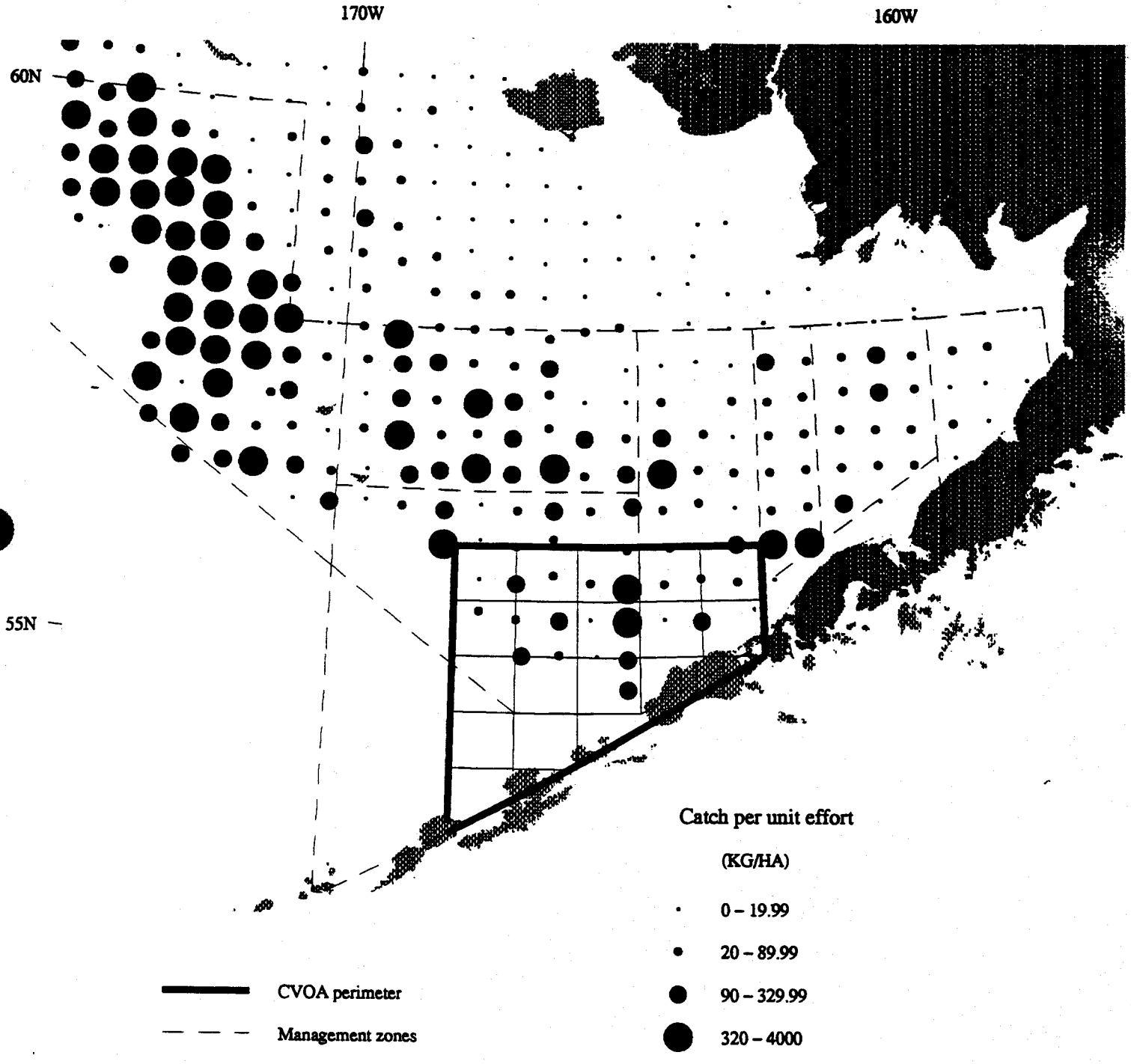


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 49. Figure description printed prior to Figure 44.

1988 Pollock

Greater than or equal to 34 centimeters.

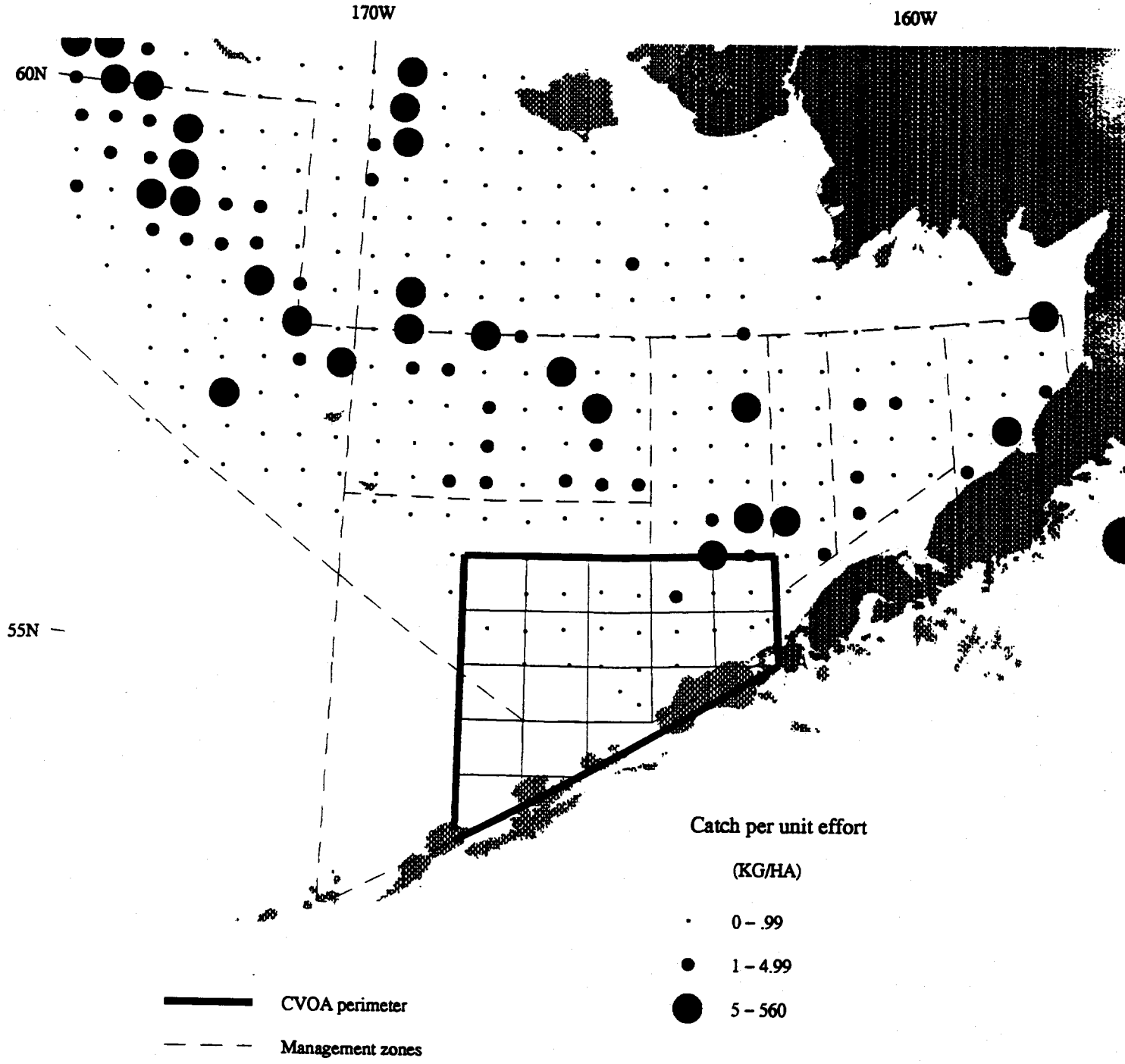


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 50. Figure description printed prior to Figure 44.

1993 Pollock

Less than 34 centimeters.

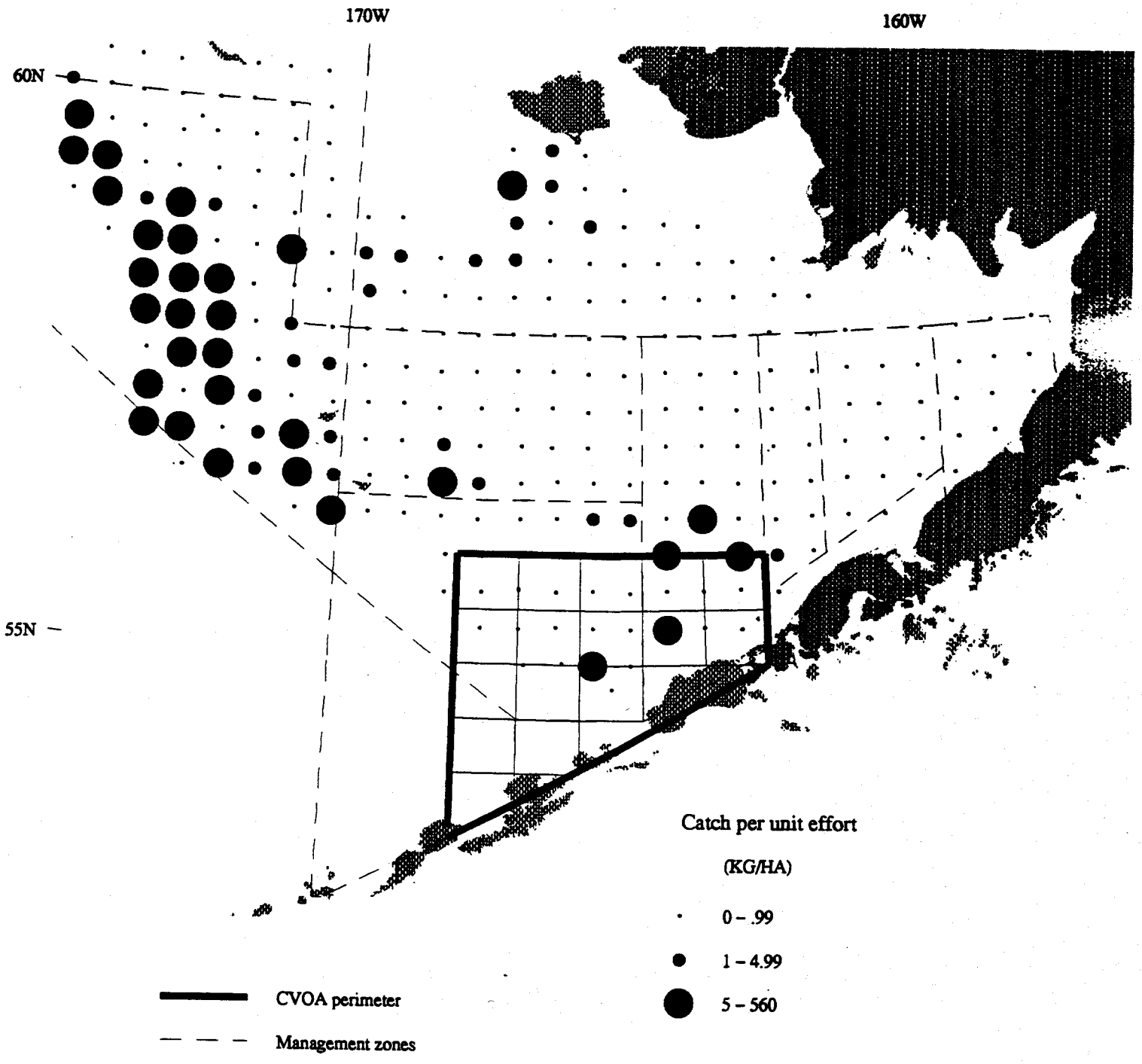


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 51. Figure description printed prior to Figure 44.

1992 Pollock

Less than 34 centimeters.

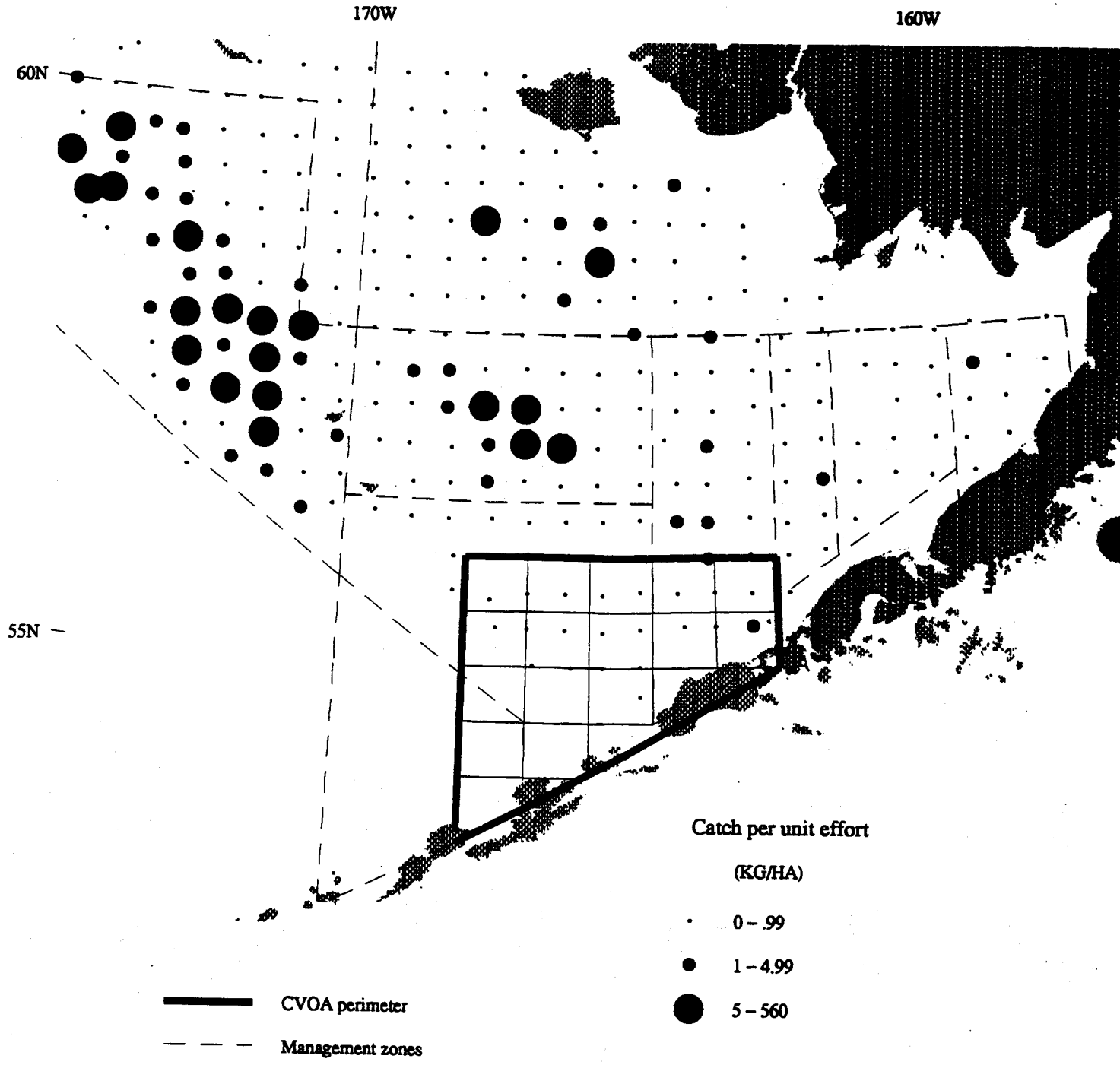


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 52. Figure description printed prior to Figure 44.

1991 Pollock

Less than 34 centimeters.

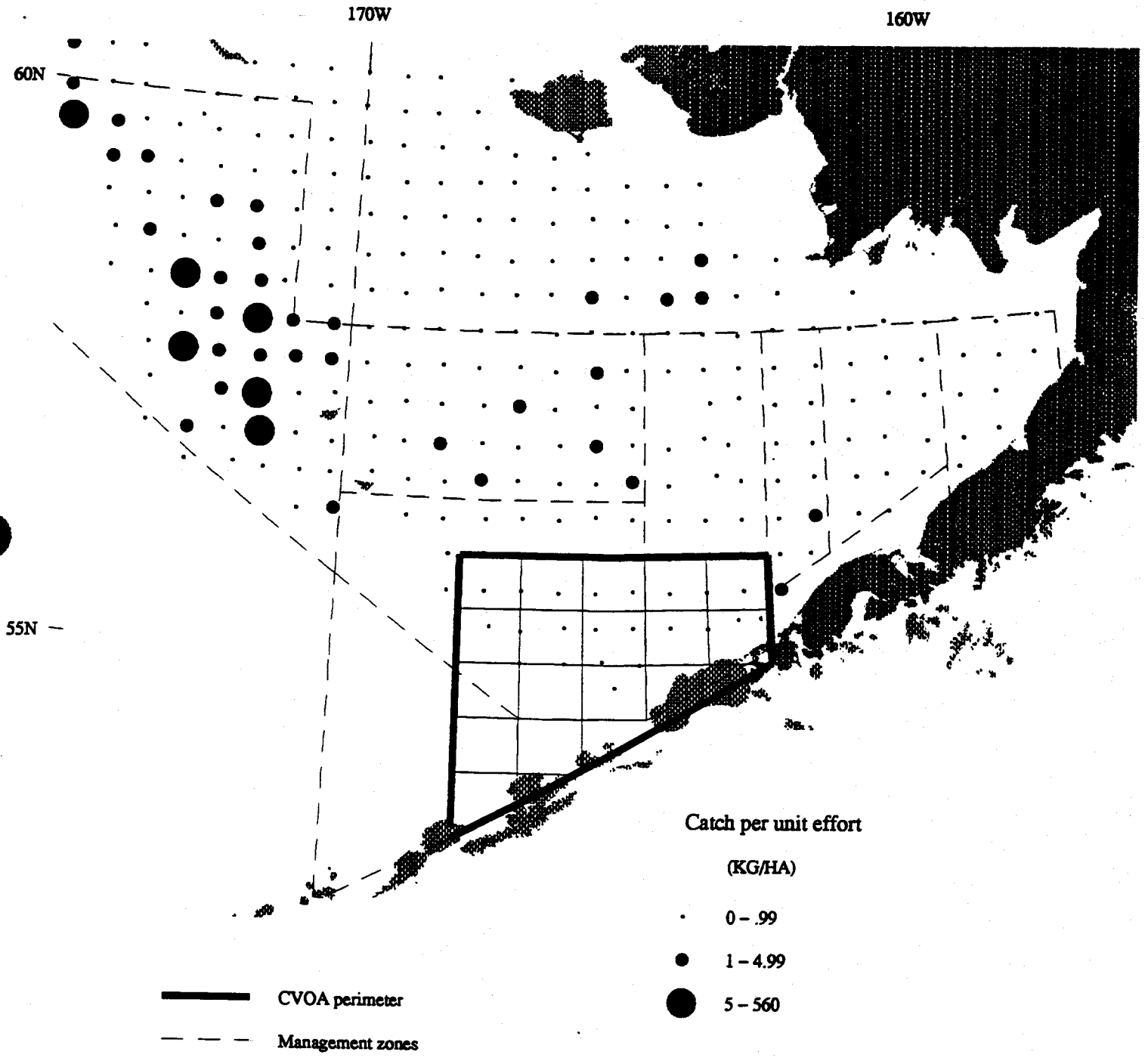


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 53. Figure description printed prior to Figure 44.

1990 Pollock

Less than 34 centimeters.

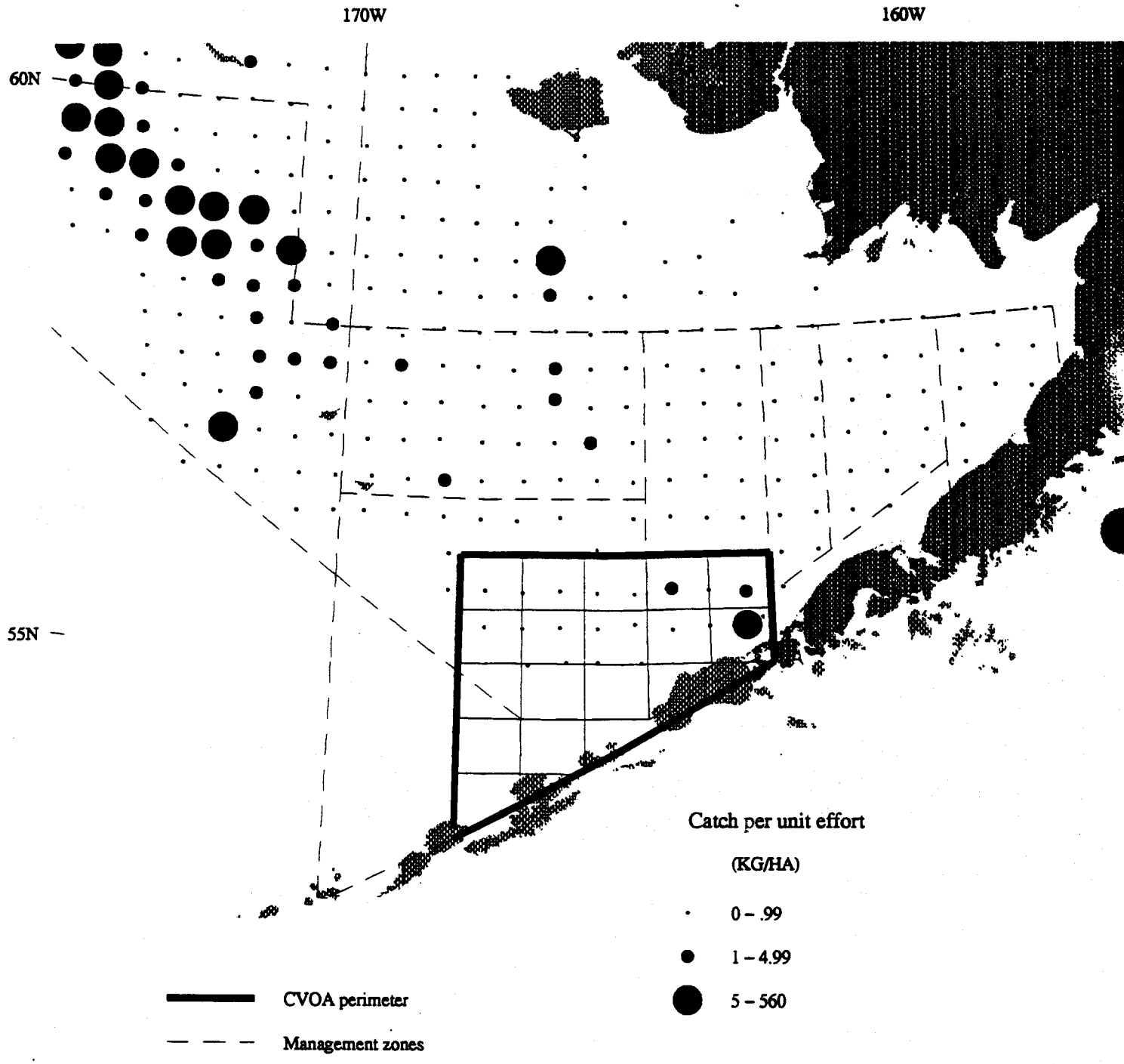


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 54. Figure description printed prior to Figure 44.

1989 Pollock

Less than 34 centimeters.

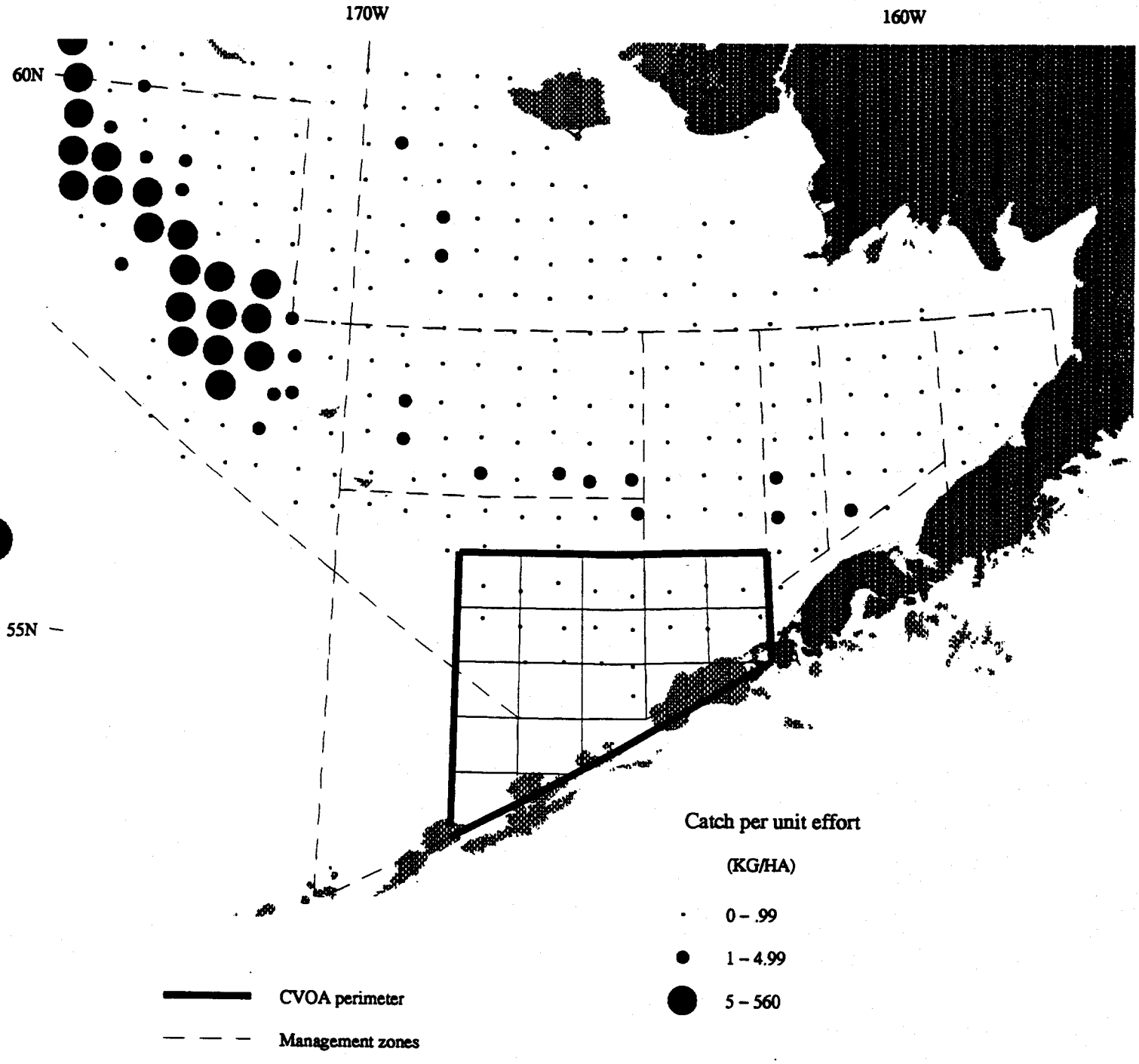


Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.

Figure 55. Figure description printed prior to Figure 44.

1988 Pollock

Less than 34 centimeters.



Source : RACE Survey, National Marine Fisheries Service, 7600 SandPont Way N.E., BIN C15700, Seattle, WA 98115.